PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

FEB 10 1925

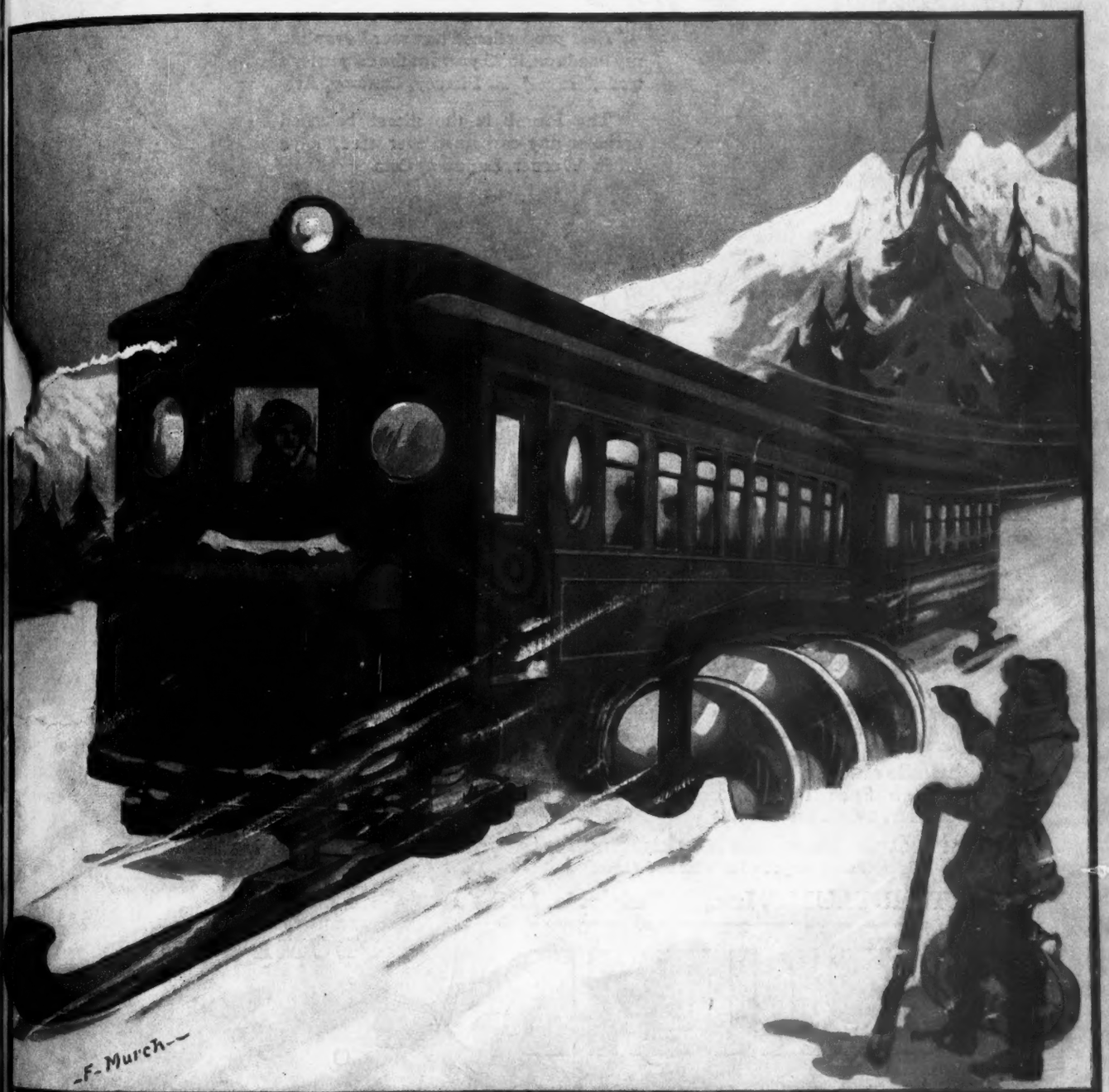
Popular Science

FOUNDED MONTHLY 1872

A CROSS-WORD PUZZLE CONTEST—p. 38

Prizes offered to test your knowledge of practical words

Amazing fascination of puzzles explained.



MARCH

Bus with corkscrew drive supplants Arctic dog teams

25 CENTS

This Edition Over 400,000 Copies

Plumb Hammer cut away to show Plumb Take-up Wedge, which retightens the handle with a turn of the screw.

"Best proportioned hammer I ever had my hands on, in 25 years at the carpenter's trade," says J. R. Piercey, Conway, Ark.

"The Plumb is the nicest balanced hammer any carpenter ever used," says M. R. Warner, La Junta, Colo.

"Just right [in shape, in weight, in balance]"

says the carpenter

BECAUSE carpenters helped to design the Plumb Nail Hammer, it is only natural that they should find it correct in size, shape, weight, and balance.

For Plumb put into this finer tool just what you want in your hammer:

—a larger face that works with you to hit the nail on the head;
—a shorter neck that lets the weight come close to the head of the hammer;
—claws bent more sharply, to make your nail pulling easier;
—the Plumb Take-up Wedge, to keep your handle always tight;
—Plumb Special Steel, tempered hard for service, tough for wear.

Your hardware merchant has this hammer for you.

Price, $1.30 (except in Far West and Canada).

FAYETTE R. PLUMB, Inc., Philadelphia, U. S. A.

Look for
THE
Red Handle
WITH THE
Black Head
(Color Combination Registered as Trade Mark, U. S. Pat. Off.)
EXCLUSIVELY
PLUMB

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
March, 1925

How Electricity May Solve the Farmer's Problem

The story of a tremendous effort to provide six million American homes with labor-saving machinery and tools

By Charles H. Huntley

IN THE last 30 years the number of acres of improved farm land in the United States has decreased, because of population increases, from 5.6 to 4.2 a person. If the American people—not to mention those of other countries who buy a part of their foodstuff from us—are to continue to be fed by American farms, either more land must be cultivated or that now utilized must be made to grow greater crops. As to that, economists and agricultural experts long have been agreed.

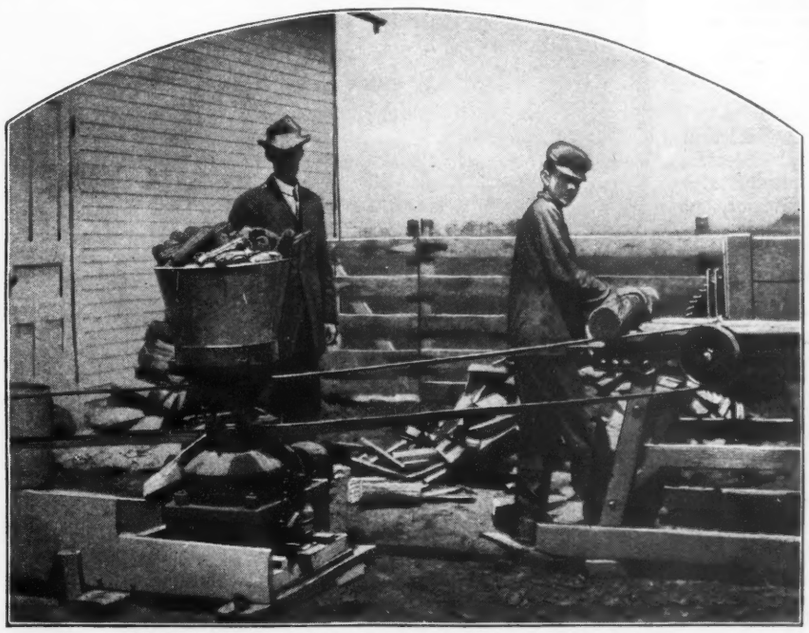
Generally speaking, the amount of land that can be used for raising crops is limited, and we are approaching the limit. On the other hand, the population is increasing continuously.

THE obvious solution of the problem is to obtain larger returns from what already is classed as farm land, much of which now is tilled insufficiently, or not tilled at all. Better methods of farming must be adopted, waste of time and labor must be lessened, and sufficient power and the mechanical means for applying the power to the work must be provided. Not the least important aspect of this problem is the necessity for making good the deficiency in man power caused by the steady emigration from the rural districts to the cities, which in the first 20 years of this century resulted in a shift of about 11 per cent in the relative status of population between city and country, and which still continues.

Now, is there anything that offers a solution of all these difficulties—any single means that will compensate for the removal of farm workers to the cities, and at the same time make possible the cultivation of the additional farm land necessary to feed our growing population?

Electricity may.

Electricity would bring to the farms—actually does bring in cases where it is used—many of the conveniences of city life, the pursuit of which undoubtedly is a principal reason for the emigration from the farms. Electricity supplies a possible way of enabling one man on a farm to do the work ordinarily done by several. Electricity possibly supplies a means of creating industrial "side lines" in the rural sections, which can be followed by farmers when there is no farm work. Electricity offers, in consequence, a possible way of increasing the farmer's income, building up the rural villages, bringing about an expansion of social life and activities in the country districts.



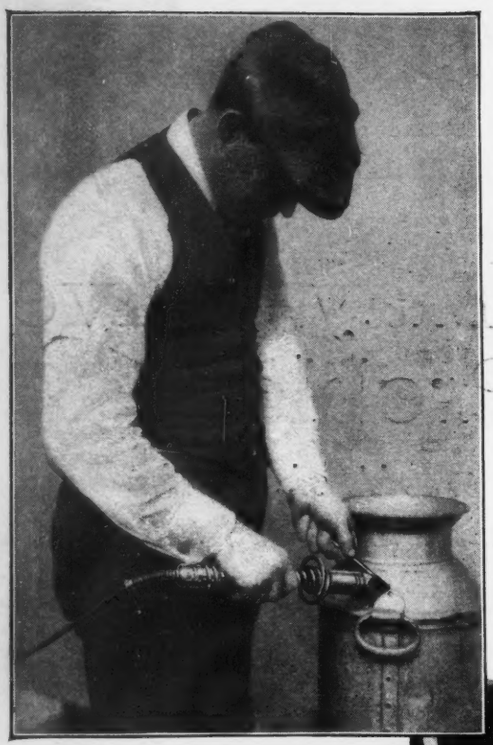
Motor Power Grinds the Feed and Saws the Wood

An electric feed grinder and wood saw in operation on the farm of Samuel Leman, Eureka, Ill. A five-horsepower motor can saw enough wood in a few hours to last for weeks. The feed grinder is automatic. The farmer simply fills the hopper and the machine grinds the grain until the hopper is empty. Then it stops. Authorities estimate that men on farms equipped with such labor-saving machines each are able theoretically to do the work of 100 men. The energy output of an average workman is rated at about a tenth of a horsepower. But one man easily can control the work done by a 10-horsepower machine and thus, by putting electric power to work for him, expand his own strength 100 times

ELECTRICITY may, in short, cause the dawn of a new era in American agriculture.

The statements just made are qualified, for the reason that no one knows just to what extent electricity can do these things. Soon, though, that information will be available, for farmers, farm engineers, electrical engineers, light- and power-station men, makers of farm machinery, manufacturers of electrical apparatus, and agricultural schools recently have united to attack the problem of farm electrification.

An organization including these groups formed for the specific purpose of studying the matter has been organized—the Committee on the Relation of Electricity to Agriculture. It consists of representatives of the American Farm Bureau Federation, the National Grange, the



Odd Jobs Simplified

With an electric soldering iron, the dairyman can keep his milk cans in perfect repair with a great saving of time and inconvenience over the old blowtorch method. Of 6,448,343 farms in the United States, according to the last census, it is estimated that about 348,000 had electric service to permit the use of such time-saving devices

American Society of Agricultural Engineers, the National Electric Light Association, the United States Departments of the Interior, of Agriculture and of Commerce, and various manufacturers of electrical apparatus. It maintains headquarters at Chicago, under the charge of a director, and has branches, each charged with studying the problem in its state, in several states. These branches are in Alabama, California, Iowa, Illinois, Minnesota, New Hampshire, New York, Oregon, South Dakota, Virginia, and Wisconsin. There are prospects that branches soon will be formed in other states.

ELABORATE preparations, you may say, for so simple a matter as leading a feed wire from a transmission line to a farm. And, too, you may wonder why farms, like factories, were not electrified long ago.

The reasons are not hard to find. When electric drive for machinery first entered the industrial field, it found power in use in large quantities in mills and factories. Hence it was a question simply of supplanting steam or water power; of substituting a motor for the engine or water wheel. Moreover—and this is an extremely important point—the factories were centralized in communities. Electric power could be distributed to a number of them within a short distance from the central station where it was generated. Since it costs more than twice as much to distribute electric power as to generate it, the expense of supplying it increases with the length of the distributing system. Also, following the closing of the mills for the day, came another "load" for the generators—the lighting of the innumerable homes of the factory workers, which meant that the generating machinery could be kept continuously busy and hence profitable.

But in the case of the farm, the situation was entirely different. The individual farm is, even yet, in cases where electricity is used at all, a small user of electric power. And whereas there may be a dozen factories within a few city blocks of a central station, the average distribution of farms is only a few to the mile.

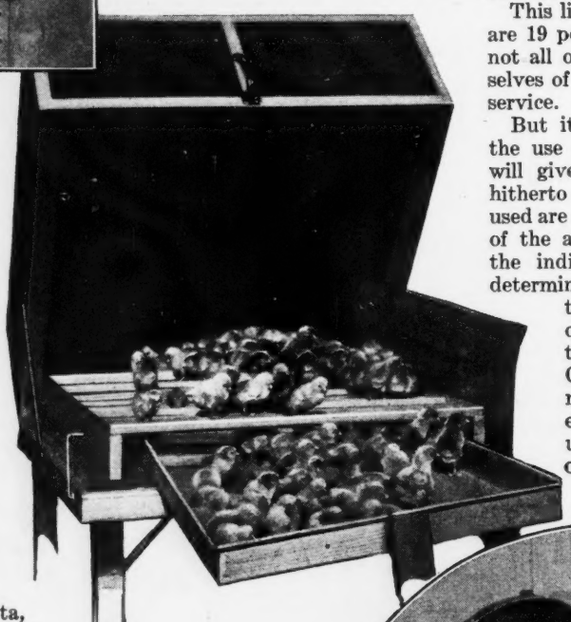
It is true that the aggregate amount of power used by the farming industry is huge. The last census showed more than 20,000,000 horses in the United States, most of them on farms. In addition, an enormous total horsepower is represented by tractors, gasoline engines, windmills, and other devices of the kind. Notwithstanding all this, the use of power is widely scattered and the individual farm does not, with the present farm application of electricity, offer a large load.

However, in the aggregate, there is a big field for electricity in agriculture. Farming is the country's basic industry. It represents an investment of more than $77,924,000,000 in land, buildings, live stock, implements and machinery, and it produced in 1923, the last year for which figures are available, wealth amounting to $16,064,600,000. Also it is an industry that directly furnishes the livelihood of 29.9 per cent of the country's people.

IT IS this big field that engineers and economists have set out to open up to power-distribution lines. Practical work already has begun. State branches, as I have said, have been organized. Under the auspices of the Minnesota Committee, for example, an experimental line has been constructed near Red Wing, Minn., that promises to be one of the most important steps ever taken in the direction of farm electrification—one that may bring untold benefits to American farmers.

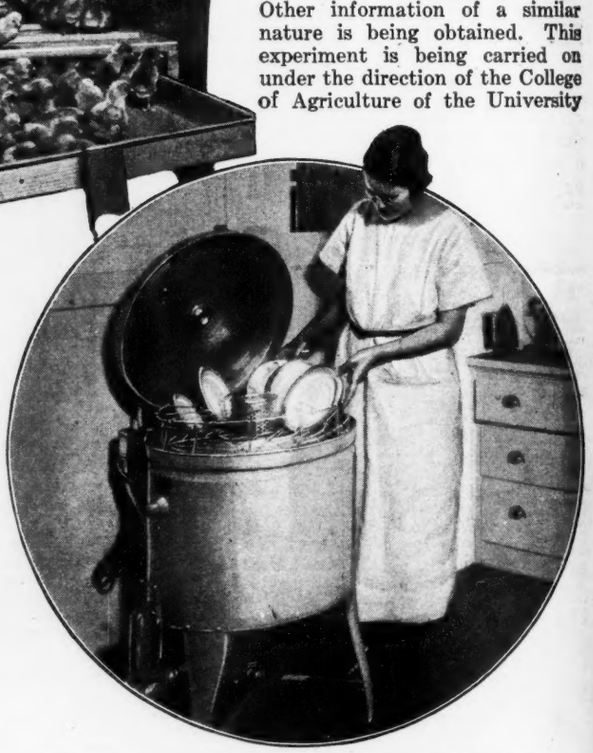
This line is only 6.3 miles long. There are 19 possible customers living along it, not all of whom yet have availed themselves of the opportunity to have electric service.

But it is a laboratory experiment in the use of electricity on the farm that will give data of immense importance, hitherto lacking. The various devices used are equipped with meters and records of the amount of current consumed by the individual machines are taken to determine the cost of operation. The time used in doing specified items of farm work with and without the use of electricity is noted. Other information of a similar nature is being obtained. This experiment is being carried on under the direction of the College of Agriculture of the University

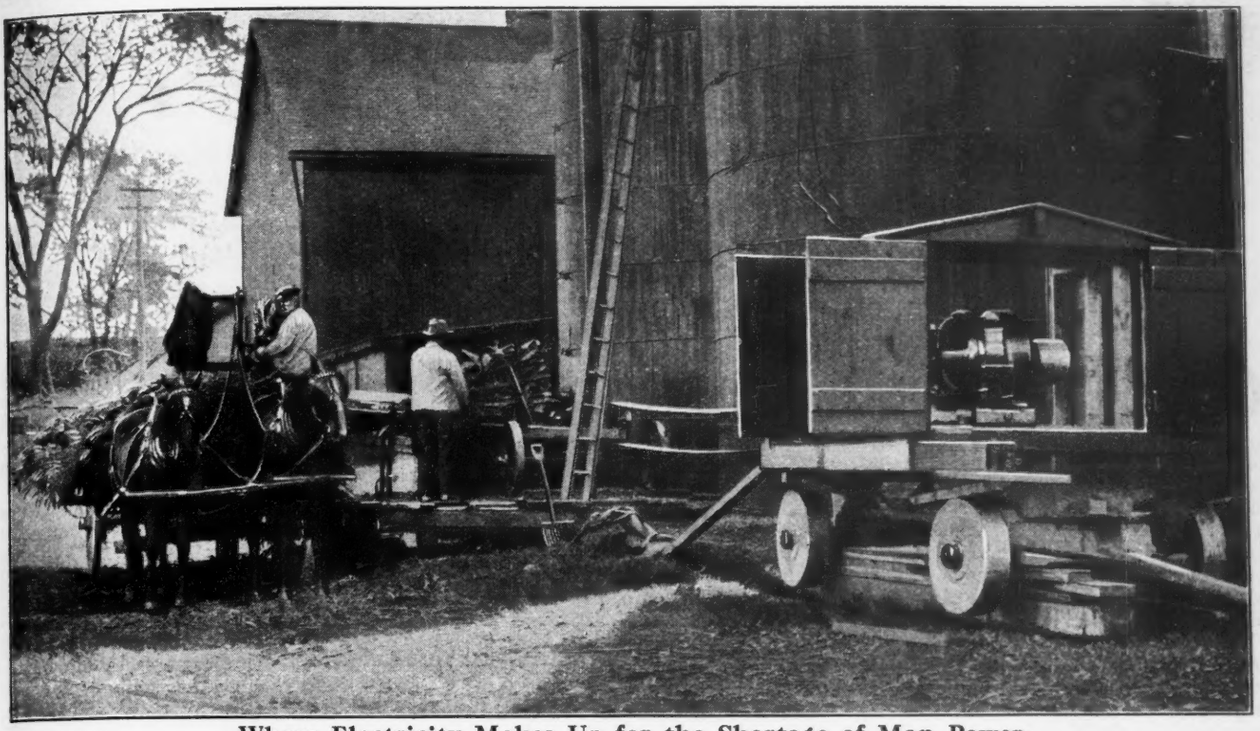


Just Hatched

This electric incubator hatches 250 eggs at a time. In recent experiments at Red Wing, Minn., a hatch of 77 per cent was obtained from an electric incubator, as compared with 55 per cent from an oil incubator operated by the same poultryman



Electricity frees the farmer's wife from rural bondage. This dish-washing machine is but one of a number of electrical devices that have brought to a South Dakota farmhouse every convenience of the up-to-date city apartment



Where Electricity Makes Up for the Shortage of Man Power

A 15-horsepower motor cutting silage on the farm of Fred C. Crane near Dalton, Mass. Notice that only two men are employed to perform work that ordinarily requires a large crew. It is in making up for the alarming emigration of man power from country to city that electricity offers the most promising solution of the farm problem. In the 20 years from 1900 to 1920, the shift of population from rural to urban districts was about 11 per cent. In 1900, 40.5 per cent of the population of the United States lived in communities of 2500 or more. Ten years later this proportion had increased to 45.8 per cent, and in 1920 to 51.4 per cent. Now motor power is proving a substitute for human labor lost to the farms

of Minnesota. Current was turned on the line about a year ago, and the work will be continued for three years.

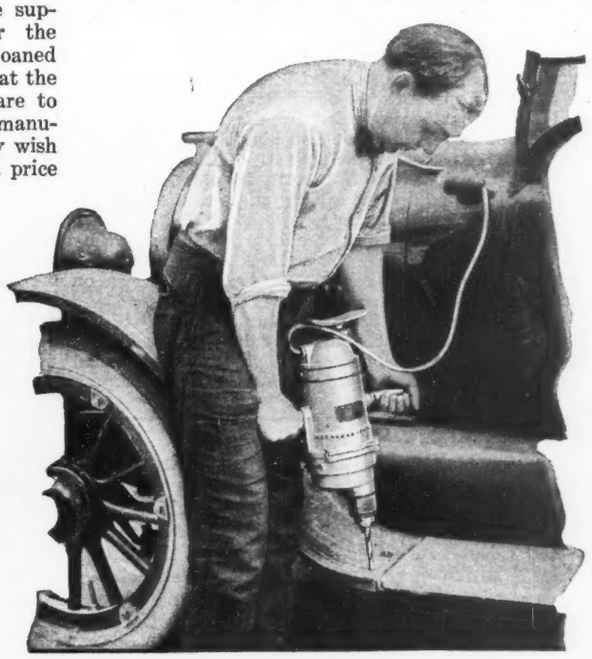
ABOUT 40 manufacturers of electric motors and appliances, farm machinery and barn equipment have supplied the apparatus needed for the experiment. This equipment is loaned to the farmers for three years. If, at the end of that time, they do not care to keep it, they can return it to the manufacturers without expense. If they wish to retain it, they may buy it at a price agreed upon when the installation was made.

The Red Wing experiment might be described in detail, but it seems unnecessary here. A few specific accomplishments, however, may be mentioned as showing what electrical power already has done in that section.

It has been found that on one farm about four tons of feed are ground a week. Corn, oats, and barley are handled five times, and three men, a team and a wagon are employed in the process. By the application of electricity it is hoped the work may be done automatically.

One family was about to leave the farm when the experiment was begun. Now they have decided to stay. The wife is getting along without the ever-troublesome hired-girl question staring her in the face. The husband for the first time in his life is indulging in a luxury which he always craved—leisure.

Another man, whose house was in need of repairs, had almost decided to move to town rather than undergo the expense of making necessary alterations. Since the installation of electric power, however, he has completely renovated and painted the house and has made up his mind to remain on the farm permanently. For electricity has provided him with every comfort he might expect to find in the city—hot water for his bath, heat for his cooking and light for his home, as well as water for his stock and power for his machinery, lessening his labors.



How the Farmer Saves Repair Bills

With electric power tools at hand, the farmer no longer need waste time and money going to town for repairs on his auto and his farm machinery. This farmer is boring holes in a fender with an electric drill, a tool that has innumerable uses about the farm. The number of farms on which power for such tools now is available from light- and power-station distribution lines is estimated at 166,000. In addition, the number of individual farm power and light installations is somewhere between 200,000 and 400,000

Women, too, are being freed by electricity from rural bondage. One young woman told an investigator that all her washing and ironing is done now in a day instead of requiring a day and a half of her time and half a day of her father's.

EVEN unborn chicks in the shell are touched to greater endeavors by the magic wand of electricity. Two incubators side by side, with eggs from the same hen, and operated by the same experienced poultryman, gave interesting results. A hatch of 55 per cent was obtained from the oil-operated incubator, and 77 per cent from the one heated by electricity. The operator reported, too, that more cripples came from the oil-operated machine.

Experimental work similar to that at Red Wing is in progress in a dozen or more other places, notably in Alabama.

From all this it should not be assumed that electricity is not being used on farms to any considerable extent. It is being successfully employed on a number of them.

(*Continued on page 160*)

Why Everybody Is Solving Cross-Word Puzzles

Columbia University psychologists explain the fad's great fascination—A new test of your acquaintance with science

By H. E. Jones, Ph.D., and Prescott Lecky, M.A.

CHINESE game sets have found their way to bargain counters, and the strains of "Bananas" no longer filter in through your radio set; but a new frenzy is upon us, claiming more—victims, shall we say?—than any other fad of recent memory. Perhaps it has already overwhelmed you, for few have escaped the Cross-Word Puzzle Bug. From dawn until midnight people everywhere are rushing about in distracted search for seven-letter words meaning "three-toed," and two-letter words meaning "exists." Millions of people these days seek no further happiness than that supplied by a cross-word puzzle and a dictionary.

The University of Kentucky puts cross-word puzzles in the college curriculum. A professor at Princeton University offers a prize for a puzzle having two different correct solutions. A Pittsburgh minister crowds his church by erecting a cross-word blackboard and inviting the congregation to puzzle out the text before he starts to preach. A New York judge, on a wife's complaint, imposes for one addict a legal limit of three puzzles a day. Dictionaries are in such demand in the public libraries that in New York City the library officials prohibit their use by cross-word enthusiasts; in Los Angeles each user of library dictionaries is limited to five minutes in his search for the missing letters in his puzzle.

Old and young fight for seats in cars so that they can rest their cross-word puzzles in comfort on their knees. Children who rebel at spelling lessons suddenly have become interested in their letters.

SO THE cross-word puzzle craze has swept across the United States like a devastating fire, consuming all in its path. What, though, are the reasons that justify its continued existence? Do the puzzles, as a noted editor insisted a few weeks ago, constitute a remarkable educational force? Are they, as some hold, a sort of short cut to the acquisition of general information of a useful sort?

A moron would be as helpless with a cross-word puzzle as with a game of chess. He possesses only to a limited degree the resourcefulness, readiness to try new "leads," quickness in perceiving and criticizing his own errors, shrewdness in making guesses when subtle clues are given that stand the confirmed puzzle victim in such good stead. Are we, then, to say that general intelligence is a primary factor in the ability to trace the elusive cross words to their lair?

The writers recently tested this theory experimentally at Columbia University, New York. Separate copies of the same puzzle were given to a group of students. The students were instructed to fill in the words as fast as they could until the signal to stop was given. After 30 minutes the papers were gathered, and the number of correct words tallied for each student. In this way a "cross-word score" was obtained. Then the class was given an intelligence test of the type familiar in school and college work.

What was the result? Well, it was found that the students who scored highest in the puzzles tended to score highest in the intelligence tests also. In fact, the relationship between the two was so high that we may regard the cross-word puzzles as fairly good intelligence tests in themselves.

But entirely aside from the question of their actual human value, just what is the secret of the amazing, almost hypnotic lure of these black and white squares? The Chinese game knew no such vogue; neither did the "every-day-in-every-way" formula of Coué. Other fads—diabolo, burnt-wood engraving, pingpong and crokinole, for example, were swept along on the crest of a concerted wave of enthusiasm for a year or so, only to collapse at last and to disappear. But the wave that carries the cross-word puzzle craze mounts higher and higher every day, and—from the point of view of the present writers, at least—its collapse seems ever farther in the future. Why?

To explain scientifically why the cross-word puzzle has become *the* fad of today is not difficult. We must do little more than repeat the early history of every new vagary of the past. The important reasons behind the birth of each of them have been the same—first, prestige; and second, publicity.

THE Chinese game, you remember, first became popular on Fifth Avenue; bobbed hair came from Irene Castle and the movies; golf was the game of millionaires; police dogs were the pets of society folk. And so it is not surprising to find that cross-word puzzles received their first impetus from a group of well-known writers of New York. Though the puzzles had appeared more or less regularly in Sunday newspapers and magazines for a decade or so, it was not until these writing folk found them a worth-while diversion that others saw reason to try them too.

AND publicity did the rest. The cross-word puzzle soon found its way into the news and editorial columns, into comic strips, vaudeville acts and the radio. From eye to eye and ear to ear the story

(Continued on page 164)

Can You Solve It?

A Prize Contest Announcement

HERE is a chance to indulge in the latest fad, to test your knowledge of general science and the mechanical arts and possibly to win a cash prize.

On the opposite page is a cross-word puzzle. Almost every word it contains has some scientific or mechanical application. You probably have encountered all of them at some time or other in POPULAR SCIENCE MONTHLY. Most of them are in the present issue.

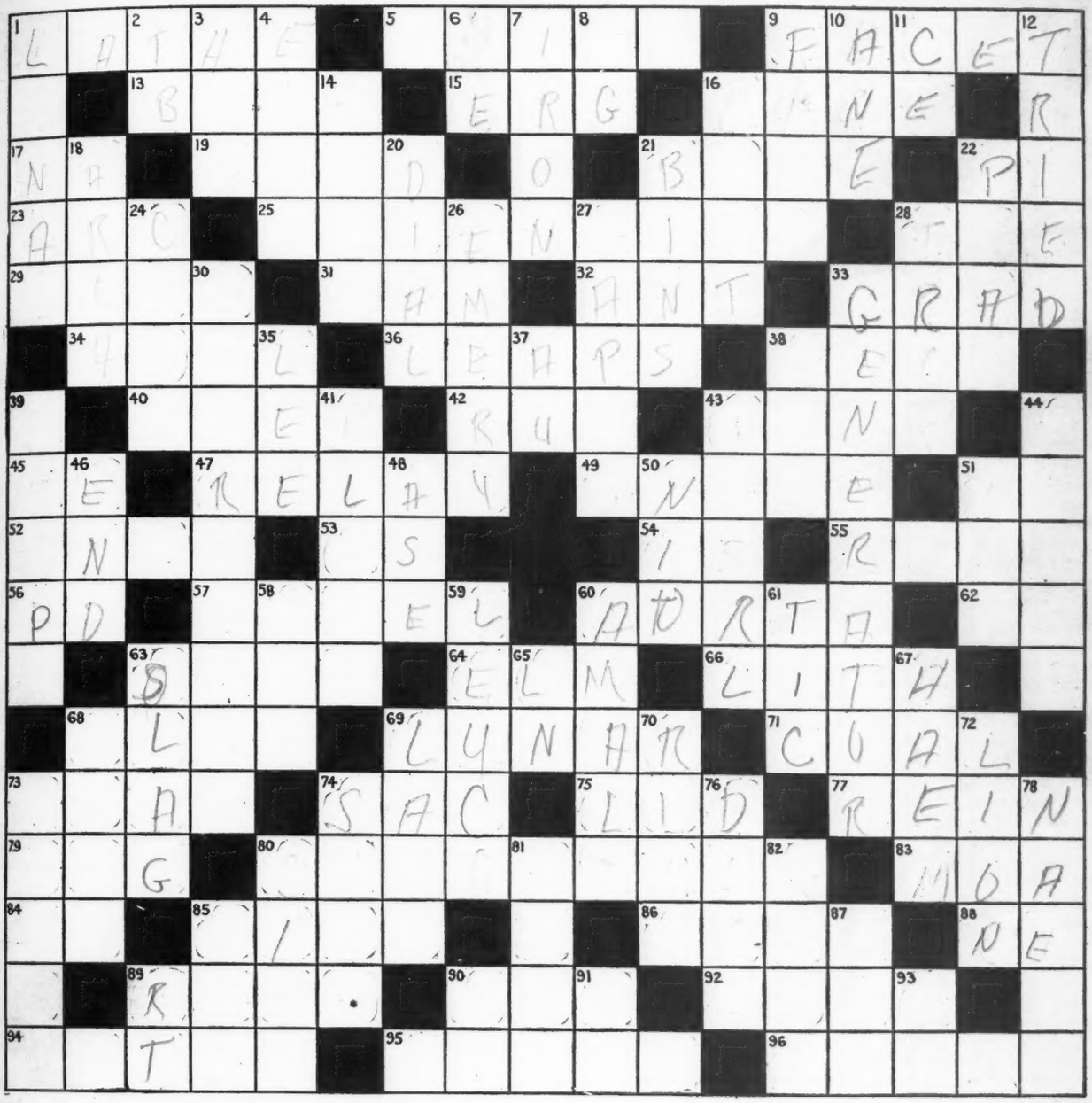
Read Doctor Jones' and Mr. Lecky's fascinating story of the craze and then try to solve the puzzle. If you succeed, send your solution and a letter of not more than 250 words telling the most interesting thing you have learned from solving this puzzle to the Cross-Word Puzzle Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.

For the best letters, accompanied by correct solutions, these prizes are offered: $50, first prize; $25, second prize; and prizes of $1 each for the next 10 best letters.

No letter unaccompanied by the correct solution to the puzzle will be considered. There is only one such correct solution and it is that in the custody of the Cross-Word Puzzle Editor of POPULAR SCIENCE MONTHLY. A board of editors of this publication will be judges of the contest and their decision will be final.

It is not necessary to use the diagram shown on the opposite page. You may trace the squares from a friend's copy of POPULAR SCIENCE MONTHLY or from copies on file in libraries, reading-rooms, etc.

Competition closes April 10. Announcement of the contest winners and the correct solution of the puzzle will be published in our July issue. Contributions will not be returned unless accompanied by a stamped, self-addressed envelope.



HORIZONTAL

1. Machine tool
5. Refracting device used in optics
9. Cut surface of a gem
13. Fastening device
15. Unit of work
16. Solid figure
17. Component of table salt (symbol)
19. Stamped
21. Hard, porous structure
22. Geometrical ratio
23. Curve
25. Savant
28. Insect
29. To enlarge a hollow
31. Radio amateur
32. Insect
33. One who has completed a college course (abbr.)
34. Indigo plant
36. Springs
38. Aquatic mammal
40. Suffix denoting members of an animal group
42. Small, bushy herb
43. Granular rock material
45. Engineering degree (abbr.)
47. Instrument widely used in telegraphy
49. Effective receiving distance of a radio set
51. Exceedingly rapid electrical vibrations (abbr.)
52. Luminous circle
53. Symbol of quality in technical merchandise
54. Very (scientific prefix)
55. Descending axis of a plant
56. Element of platinum group (symbol)
57. Adjustable instrument for measuring angles
60. Artery
62. Rare element whose name means "earthy" (symbol)
63. Commonest form of vibratory motion
64. Tree
66. Suffix frequently employed in geology
68. A shoal
69. Points of the crescent moon
71. Amorphous substance derived from ancient vegetation
73. Architectural drawing
74. Membranous pouch
75. Cover
77. Strap for controlling an animal
79. Projection in a machine
80. Meteorological instrument
83. Extinct bird
84. Common application of the wedge
85. Devices to convert rotary into reciprocating motion
86. Reverberation
88. Element found in mineral cerite (symbol)
89. Abrading instrument
90. Laboratory system of measurements
92. Prefix denoting self-contained power and the like
94. Lettering on architectural drawing
95. Output of electrical power station (pl.)
96. Pertaining to an important source of light and heat

VERTICAL

1. A kind of light seen at night
2. Wasting disease (abbr.)
3. Implement used in masonry
4. Wasp of the Scoliidae family
6. Concerning
7. Important metallic element
8. Relative weight (abbr.)
9. Assortment of type
10. Chemical suffix distinguishing members of paraffin series
11. Element named for goddess of harvest (symbol)
12. Tested
14. Prefix denoting relationship to mechanical arts
16. Outlay
18. Extent of a surface
20. Used in tuning a radio receiver
21. Storage places for fuel
22. Clanging sound
24. Unit of length (Spanish)
26. Abrasive
27. Type of drill shank
28. Small, slender nail
30. Germlike
33. Source of electric current
35. Sheltered side (naut.)
37. Precious element (symbol)
38. Bend downward
39. Sea-urchin
41. Vigorous
43. To emboss or flute
44. Rearward (naut.)
46. Fruit-bearing part of cereal plant
48. Ferment (chem. suffix)
50. Containing nitrogen
51. Decompose
58. Science of insects (abbr.)
59. White protoplasm found floating in the blood (comb. form)
60. Extensive
61. Spasmodic twitching of muscles.
63. Metallic dross
65. Symbol used in place of a seal on documents
67. Pertaining to blood (comb. form)
68. Passage of magnetism
69. Vehicles
70. Position
72. Carnivorous mammal inhabiting Africa and Asia
73. Small form of vegetable life
74. Coarse hulled corn
76. Ten
78. Lowest possible point
80. Antidote for acid poisoning
81. Million
82. Genus of poisonous plants
85. Cornish mineral
87. Pertaining to the ear (comb. form)
89. 90° angle. (abbr.)
90. Poisonous gas (symbol)
91. Variation of important scientific degree (abbr.)
93. Termination denoting an oil (chem.)

These drawings give an idea of how the U. S. Navy's proposed super-dirigible may appear when completed. They show her gigantic size compared with the world's greatest airships; the cross-section construction of her envelope; how she may be anchored to the mooring-mast at Lakehurst, N. J., and her spacious accommodations for the passengers

U. S. Plans the Greatest Airship of All

DWARFING the giant proportions of the *Los Angeles* and the *Shenandoah*, and even the two great dirigibles ordered by Great Britain, is an air-liner proposed recently by United States naval experts. It would be by far the largest airship in the world.

With a capacity of 6,000,000 cubic feet, nearly three times that of either of the American dirigibles and 1,000,000 cubic feet more than the British ones, it could be used for regular transatlantic trips. It would carry 80 passengers on a voyage and at least 32 tons of mail and freight. Counting on 40 round trips a year between New York and London, it is estimated that the leviathan would make a net yearly profit for the United States Government of approximately $5,000,000.

In design the air-liner differs radically in several ways from any others previously built. The R-100 and the R-101, the two ships that the British are planning for passenger service between England and India in 1927, are to use hydrogen in their gas bags. But while hydrogen has greater lifting capacity, United States officials favor helium on account of its safety.

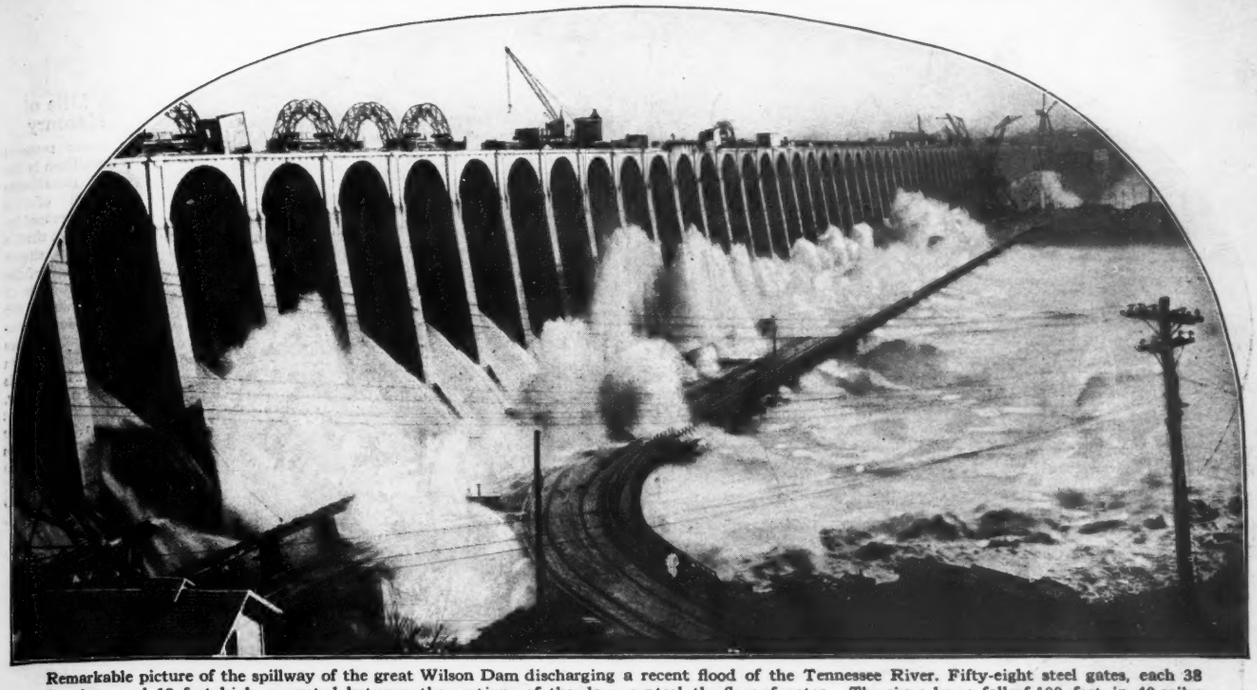
By using hydrogen in conjunction with helium, the advantages of both may be retained, and this combination is included in plans for the proposed American dirigible. Hydrogen would be used for the inner gas space, surrounded by a layer of helium that would act as a protector from fire.

The cabin, which for passenger service would contain luxuries comparable to those of ocean liners, would extend nearly half the length of the ship.

Ordinarily the ship would operate from mooring-masts. The one at Lakehurst, N. J., which is 167 feet high, could be used, but others of greater height would have to be erected. For repairs, a shed of huge dimensions would be necessary.

A dirigible with 10,000,000 cubic feet capacity, according to experts, would be capable of making non-stop flights around the world.

Rear-Admiral William A. Moffett, Chief of the Bureau of Naval Aeronautics, estimates the cost of the proposed air-liner at $6,000,000.



Remarkable picture of the spillway of the great Wilson Dam discharging a recent flood of the Tennessee River. Fifty-eight steel gates, each 38 feet long and 18 feet high, mounted between the sections of the dam, control the flow of water. The river has a fall of 100 feet in 40 miles

What Muscle Shoals Really Means

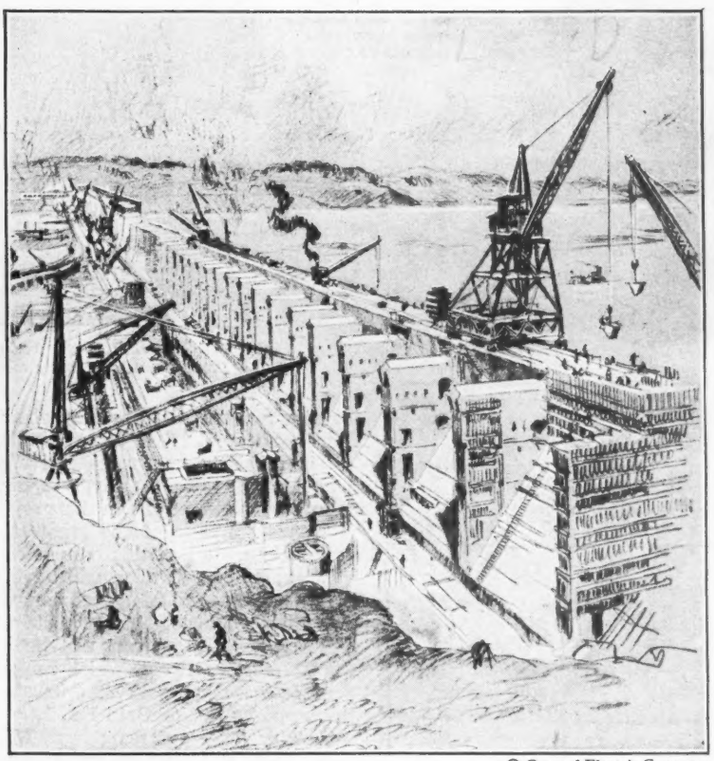
How a Stupendous Engineering Project Is Harnessing Nature

By James Knox

TO THE average person the great Muscle Shoals power-development project in northwestern Alabama probably represents another instance of inability to see the forest for the trees. Legislative and political complexities that have surrounded this great project virtually since its inception have contrived to obscure the fact that, although it is one of the vastest engineering undertakings ever prosecuted by man, its purpose and intent are intrinsically simple and hence readily understandable.

Muscle Shoals is a wide, shallow section of the Tennessee River, extending from Florence, Ala., about 260 miles from the mouth of the river 40 miles upstream. In these shoals the depth of water varies between five feet at high tide and one foot at low, making the river unnavigable, of course. Through the 40 miles of the shoals the river falls 100 feet, and the banks are high, thus suggesting water-power possibilities.

For 100 years or more inhabitants of the country have dreamed of making this section of the river navigable, for the Tennessee flows through a country rich in coal, minerals, and agricultural resources. In 1832 the State of Alabama constructed a canal about the shoals, which was partially reconstructed 35 years ago after being in disuse for years. Meanwhile almost constantly the shoals were studied to determine a method of development that would at one time open the river to navigation and supply power for the industrial growth of the country.



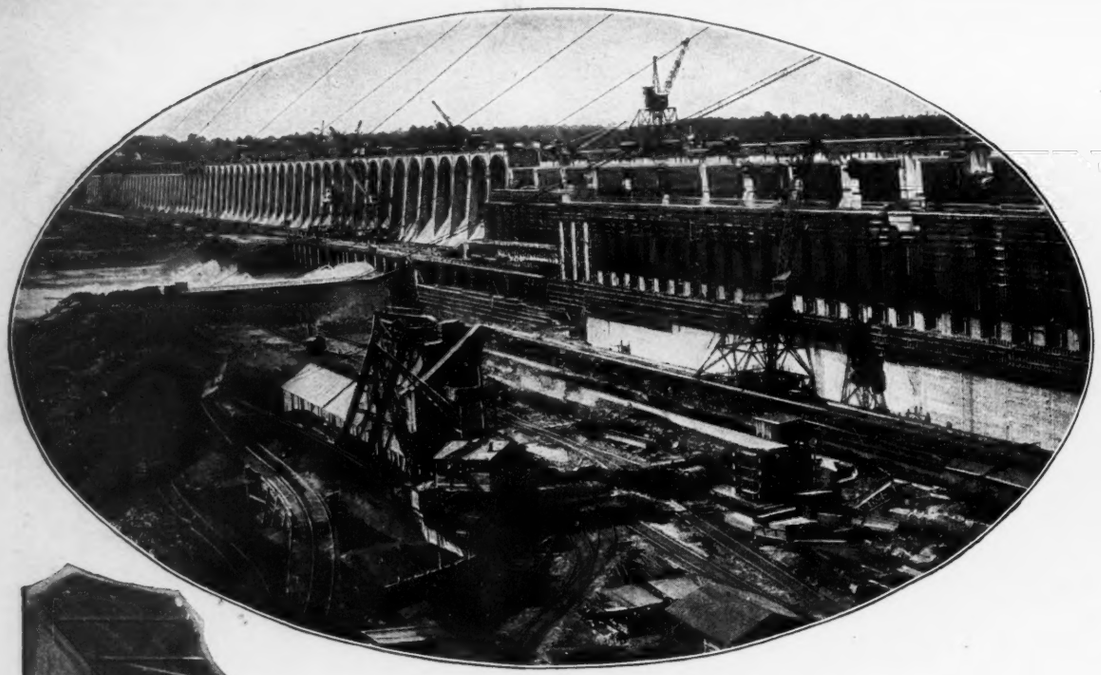
© General Electric Company

A striking view of the $51,000,000 Wilson Dam at Muscle Shoals, as sketched by the famous American architectural and landscape artist, Vernon Howe Bailey. The magnitude of this project is exceeded only by the Panama Canal

IT REMAINED for the war, however, to make the development of Muscle Shoals an actuality. Under the National Defense Act construction was begun by the Engineer Corps of the U. S. Army early in 1918 on a large plant near Muscle Shoals for the manufacture of nitrates by an atmospheric fixation process. The nitrates were to be used in the manufacture of explosives during war and for making fertilizer in peace time.

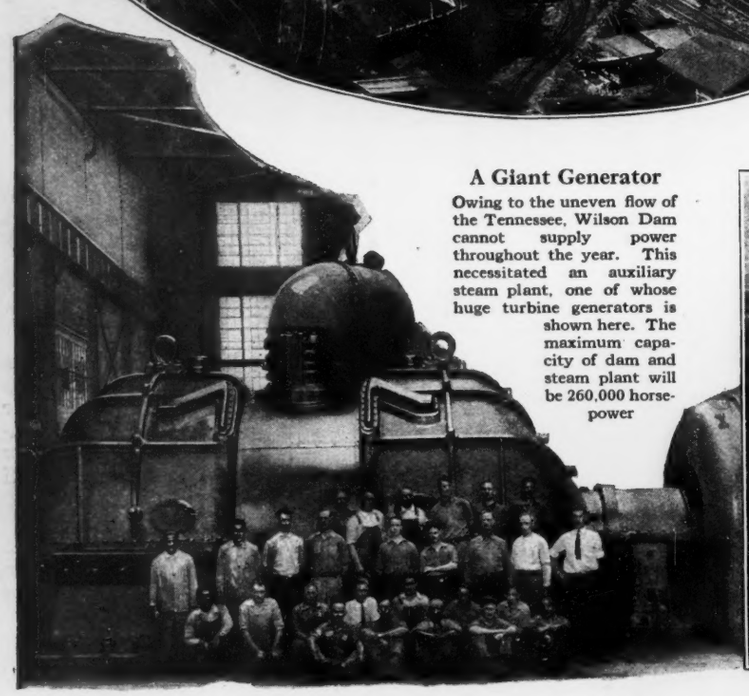
To furnish power for this work, construction of a large steam plant was begun, and later in the same year a water-power project was instituted.

This latter includes the construction of three dams and two power houses, the dams to be equipped with locks for navigation. That, from an engineering standpoint, is virtually all there is to the Muscle Shoals development—the construction of dams for power and navigation, and the construction of hydroelectric plants that will convert the water power into electric



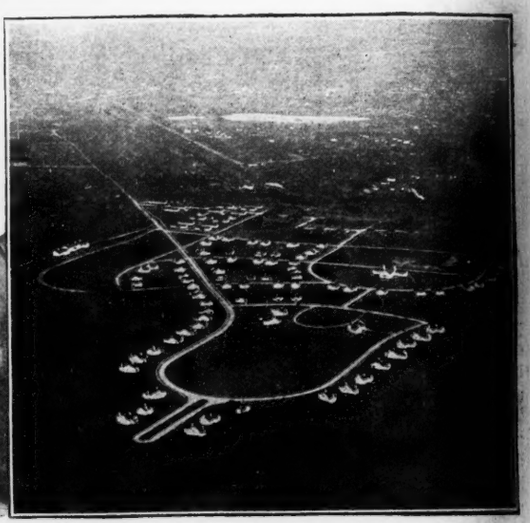
A Mile of Masonry

In many respects Wilson Dam is the most remarkable structure of its kind ever reared by man, a fact that is admirably shown by this view of the complex details of construction of the power-house section, taken from the downstream side. The dam is almost a mile long, and its height ranges from 95 to 134 feet. It covers 20 acres, and, when completed, it will contain 36,500,000 cubic feet of massive masonry

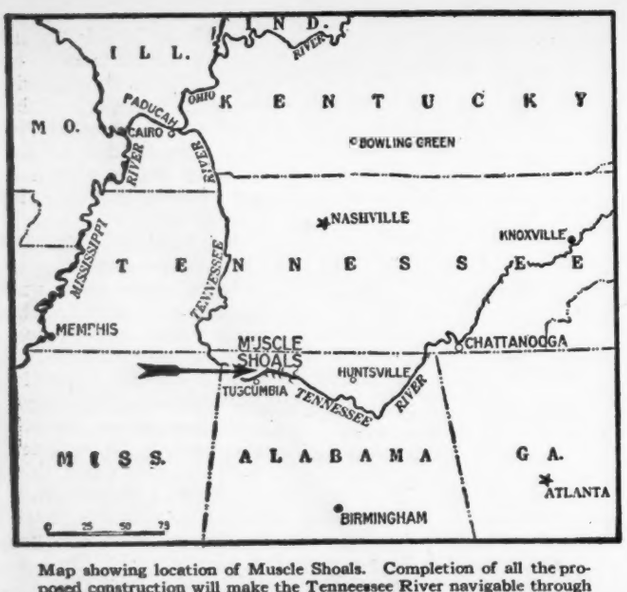


A Giant Generator

Owing to the uneven flow of the Tennessee, Wilson Dam cannot supply power throughout the year. This necessitated an auxiliary steam plant, one of whose huge turbine generators is shown here. The maximum capacity of dam and steam plant will be 260,000 horsepower



Airplane view of the workmen's village at U S. Nitrate Plant No. 1, containing modern houses and paved streets



Map showing location of Muscle Shoals. Completion of all the proposed construction will make the Tennessee River navigable through its entire length from the Ohio River at Paducah, Ky.

current for use in the making of nitrates for explosives and fertilizer and possibly for general industrial purposes also.

The dams are known respectively as No. 1, No. 2, and No. 3. Dam No. 1 is to be exclusively a navigation dam. Construction has not yet been begun on this project. Dam No. 2 is the famous Wilson Dam, one of the greatest pieces of construction ever undertaken. When this dam is completed, probably next November, its construction will have cost about $51,000,000, and it will make available, engineers estimate, a maximum horsepower of 260,000, of which 200,000 will be available continuously. The variation in output will be due to the irregular flow of the Tenneessee River, which ranges between 7350 and 500,000 cubic feet a second. This dam stands about three miles from the proposed site of Dam No. 1.

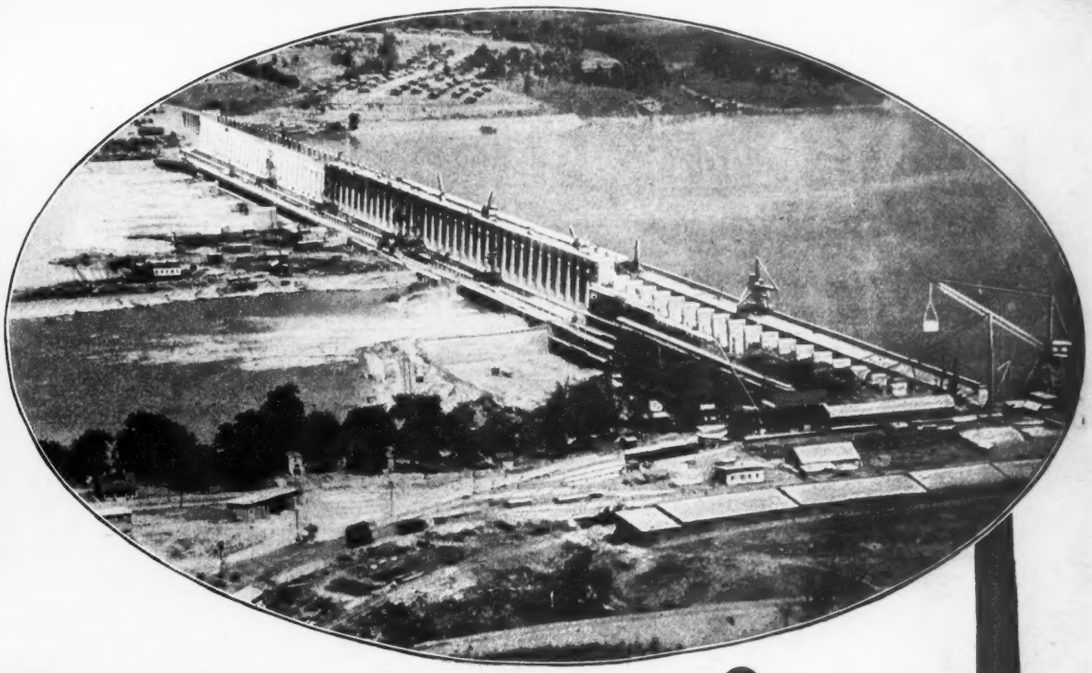
Twenty miles upstream from Wilson Dam is the site of proposed Dam No. 3, which will be constructed both for power and navigation. This dam, to cost about $25,000,000, is expected to develop 250,000 horsepower.

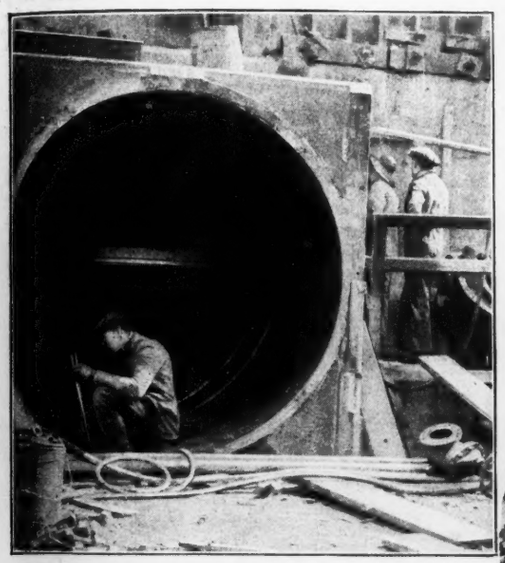
The total possible power development at Muscle Shoals is estimated at about 6,500,000, or almost the total power of Niagara Falls. That power, however, would be available only for short periods, on account of the uneven flow of the river. It is estimated that Dams 2 and 3 will give not more than 850,000 horsepower—and that for only 20 per cent of the time.

Two nitrate plants also have been constructed as part of the

Converts River into Lake

An admirable bird's-eye view of the entire Wilson Dam construction is shown at the right. The dam will back up the Tennessee River for 18 miles, creating an artificial lake averaging three-quarters of a mile in width. In addition to supplying power, the dam contains two navigation locks. When the two other proposed dams of the Muscle Shoals development are completed, the river will be made navigable through 85 miles of shoal water

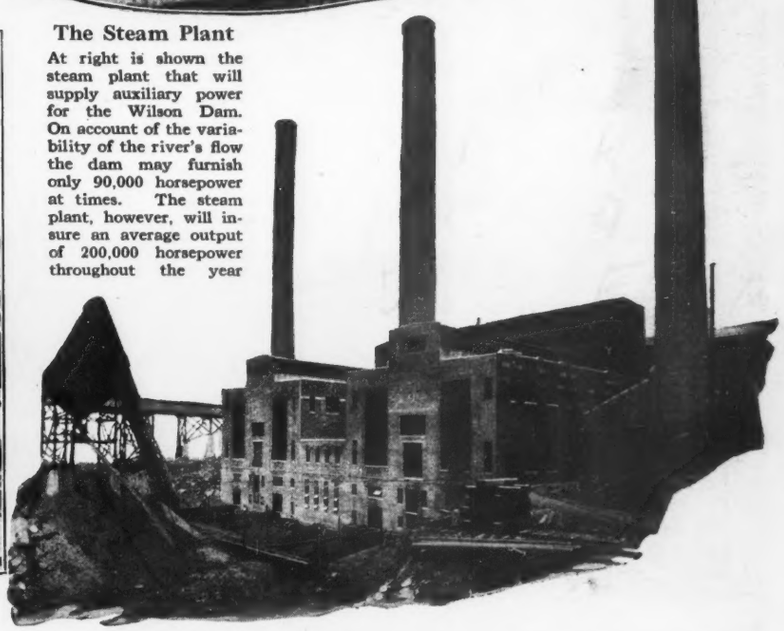




One of the valves in the sluice section of the Wilson Dam. Note the size of the man compared with the opening

The Steam Plant

At right is shown the steam plant that will supply auxiliary power for the Wilson Dam. On account of the variability of the river's flow the dam may furnish only 90,000 horsepower at times. The steam plant, however, will insure an average output of 200,000 horsepower throughout the year

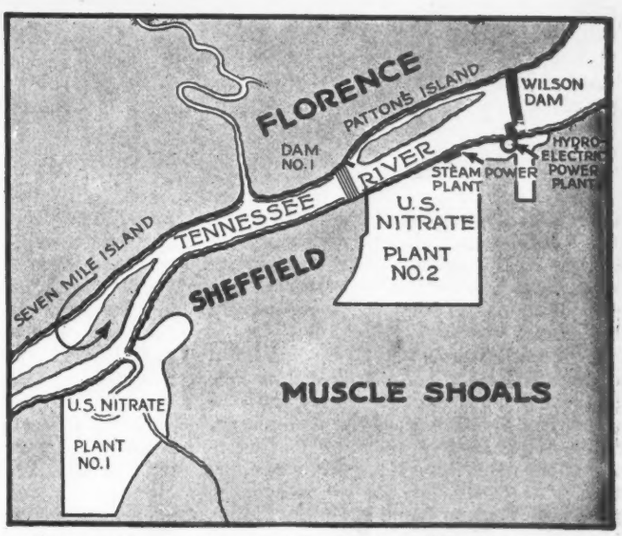


Muscle Shoals development. Nitrate Plant No. 1, built at Sheffield, Ala., about five miles from Muscle Shoals, was completed at a cost of $13,000,000 as an experimental plant to determine the efficacy of the Haber process of nitrogen fixation. Included in this development are a 5000-kilowatt steam plant and a village of 1900 acres.

Nitrate Plant No. 2 is near Wilson Dam. It is virtually completed, and is said to be the largest in the world. This plant comprises six plants essential to the fixation of nitrogen by what is called the "cyanamide process," a 60,000-kilowatt steam plant, and a town of 2300 acres.

The total expenditure of the government for Muscle Shoals development when Wilson Dam and its power plant are completed, will be $131,300,000. The completion of Dams Nos. 1 and 3 and the power house at the latter probably will raise the cost to about $165,000,000.

Various offers have been made to the government for the Muscle Shoals property, which comprises about seven square miles. Henry Ford, the Associated Power Companies, Elon H. Hooker, and the Union Carbide Company have bid for the property, but Congress has yet to make definite disposal of any of these offers. The Ford offer was withdrawn some months ago, but the others are still awaiting congressional action, which may be forthcoming before this summary of the Muscle Shoals development is printed.



This map shows location of work completed at Muscle Shoals. Proposed Dam No. 3 will be about 18 miles upstream from Wilson Dam. Proposed Dam No. 1 will be exclusively a navigation project

Single Handed He Built His Own House

A Story of an Unusual and Profitable Hobby

By W. S. Taylor

LACKING only some minor interior work to complete it, the new two-story residence of John C. Ketcham, Glen Head, N. Y., bank employee, stands to the credit of his own handicraft. Even drawing the blueprints himself, he made a personal job of every detail of actual construction, permitting no other hand to touch a tool. He built the house in 18 months, averaging about two hours a day at his work. That is equivalent to 137 eight-hour days.

John C. Ketcham laying the brick foundation for his Long Island home. "I emerged from this job a fully apprenticed bricklayer," he asserts

Mr. Ketcham's singular achievement is remarkable, not only because he did all the work himself, but also because he comes from a sedentary occupation and was without experience in any of the skilled trades so important in modern building.

Working every night by powerful electric lamps led from a special circuit, and every Saturday afternoon, rain or shine, he went forward with his building, while neighbors marveled at his determination. But Mr. Ketcham maintains that he worked solely for the pleasure it gave him, that he found the night air invigorating and the exercise wholesome, and that he is a healthier man for it.

"It is positively sport," Mr. Ketcham told me. "I have a sloop over in Long Island Sound; it used to be my hobby, but I haven't been near it in 18 months, that is, since I have been at this building. I really regret that the work is so nearly finished, because I'm afraid I'll have a hard time finding another recreation so completely satisfying as this has been.

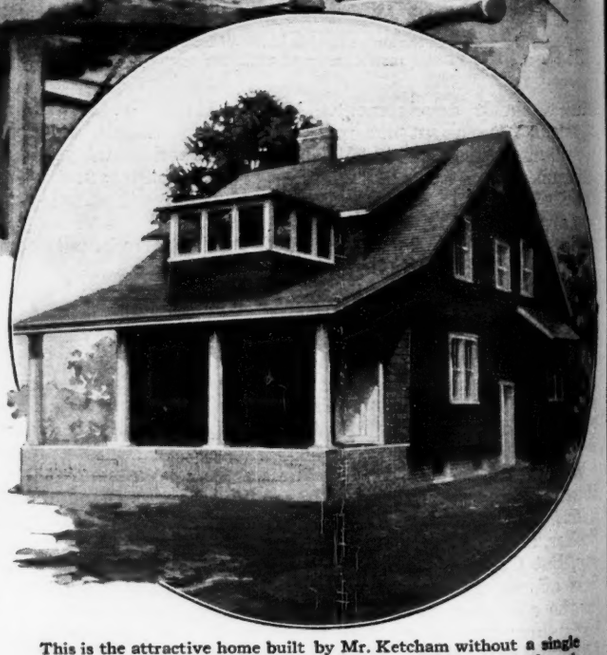
"My object in building the house myself was not one of profit. However, it is very gratifying to find that I have reduced the cost of my house more than half. I have always wanted to put up a house all by myself, nail by nail, and strictly in accordance with my ideas. As a boy in the country, I acquired a slight knowledge of the use of tools. This came back to me readily in spite of years in a profession so alien to it. However, I did encounter considerable perplexity at times, for I had never done any actual carpentry work, bricklaying, lathing, and so forth. My plans called for foundations and a chimney requiring more than 15,000 brick, laid in troweled cement courses. The moment I got this work under way, I realized that my inexperience was a far greater handicap than at first I had supposed. I had to make considerably more than the usual use of the spirit level and frequent adjustments of plumb lines to avoid sag or bulge. I might add here, that I emerged from the job a fully apprenticed bricklayer.

"I used plumb lines in leveling the floor joists, too, and in framing the porch. My greatest trouble in the latter was to get the right pitch and slope.

"No part of the work seemed to demand excessive physical exertion, except the rafters. These are of Western fir, and so heavy for one man to handle that I had to contrive a derrick in order to get them up unaided.

"Friends assured me that I should never complete the job. At first they decried my lack of experience; later they switched to forebodings of resentment by organized labor. This guess was wrong, for often a master builder or a journeyman dropped in to offer suggestions.

"Now that the house stands an accomplished fact, it is a great satisfaction to have upset the early, easy-minded conviction of my skeptical friends. And that satisfaction is the more complete in view of the fact that now those doubters themselves are planning to follow my example in the spring."



This is the attractive home built by Mr. Ketcham without a single helper. Professional builders pronounce it a perfect piece of work

Propose 88-Story Skyscraper for New York

HOW an 88-story office building would tower above the Woolworth Building, now tallest in the world, and other skyscrapers of New York, has been visualized here by our artist, using an extraordinary air view of lower Manhattan as a basis of comparison.

Such a building, rising 33 stories above the Woolworth tower, shown just to the left of it, now is being discussed by eminent architects and engineers as a possibility of the future. An interesting phase of this discussion concerns the problematical engineering difficulties to be encountered in going so high above the loftiest structure so far attempted by man.

The new building would be about 1250 feet high, or nearly a quarter of a mile, assuming that the floors would be similar in height to those of the Woolworth Building. This would make it 250 feet higher than the Eiffel Tower in Paris, the highest structure of any kind in the world, and about 460 feet higher than the Woolworth Building.

Engineers point out that exhaustive tests would have to be made to determine not only the usual stresses and strains of such a structure, but also the strain caused by resistance to the wind. When the Woolworth Building was finished, tests made in an 80-mile gale to determine what effect wind pressure had on it, showed that the building was unaffected by the strain. But just how much stronger a building half again as high would have to be to withstand the pressure of a hurricane is one of the problems that would have to be worked out carefully. To this end a detailed study of the reactions of New York skyscrapers during heavy blows is reported to be in progress. The findings may determine whether a mammoth building such as that pictured above will prove practical.

Now Comes the Air Taxi

Hundreds of people are using flying cabs to carry them to business and on pleasure trips—Remarkable new developments in luxurious passenger planes and sky "flivvers"—A forecast of future travel

By Robert E. Martin

A SHORT time ago a man called up an aviation company on Long Island, N. Y., and said his brother was dying in Chicago. He inquired if he could hire a plane to take him to Chicago at once. He could; and he reached his brother's bedside seven hours later. The air taxicab made this possible.

In an emergency the airplane taxicab is indispensable. To reach a dying parent, close a business deal in a distant city, send a salesman, catch a ship that has left a dock, or to go a distance in the shortest possible time, nothing beats the speeding airplane. And the airplane today is at the disposal of everybody.

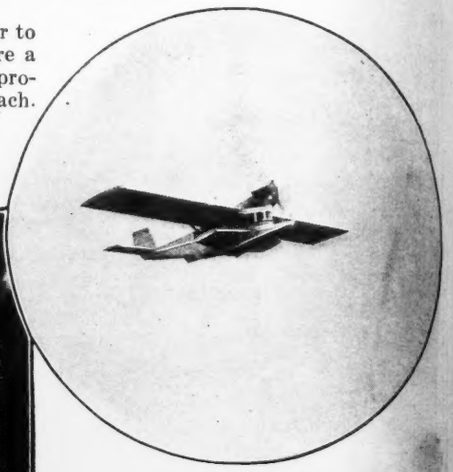
Few people realize that scarcely a city of importance in the world today is without its commercial airdrome. The system of usage at last is becoming generally known. You call the airplane company; five minutes later a car is at your door to whisk you to the landing-field. There a plane already is out. Its whirring propellers hum a welcome at your approach. Three steps up, a gentle lifting thrill, and you are winging toward your destination. The *air taxi* at last!

"Inevitable!" cried Wilbur Wright 10 years ago, when some one suggested the air taxi. No doubt he had in mind the terrific acceleration of all living in this century of wonders—radio compressing the globe to a miniature of what it was; daily air mail closely linking cities; world fliers laughing longitude out of countenance.

The motor-car has been a wonder in its day, an agency for pastime and a means for hurry to and fro. Now traffic congestion has almost killed its usefulnesses. Motor parkways have come—the land taxi's last stand. Now they, too, are jammed. To one not in close touch with the situation, the figures showing the extent to which this congestion is being relieved by sky transportation is startling.

Sky Riders Travel in Luxury

Passengers travel in delightful luxury in the latest American type of aeromarine-metal flying boat recently completed for service on the Atlantic coast. This interior view of the cabin shows how six passengers are accommodated, in comfortable "parlor car" chairs. Each chair is beside a window through which the passengers can view the scenery far below them as the plane speeds along

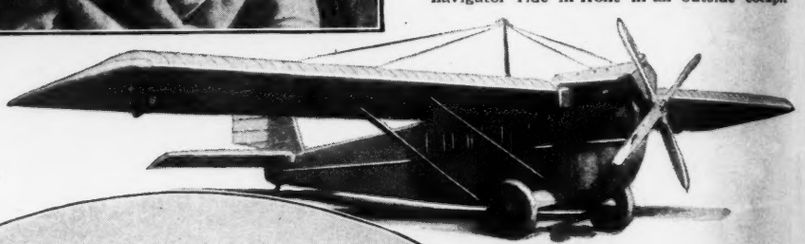


Day and Night Service

Day and night flying have become a regular feature of a new passenger airplane route between London and Copenhagen. Above is one of the Dornier all-metal flying boats in the night service. It carries 10 passengers in the scheduled service between the two capitals

Carries Passengers and Mail

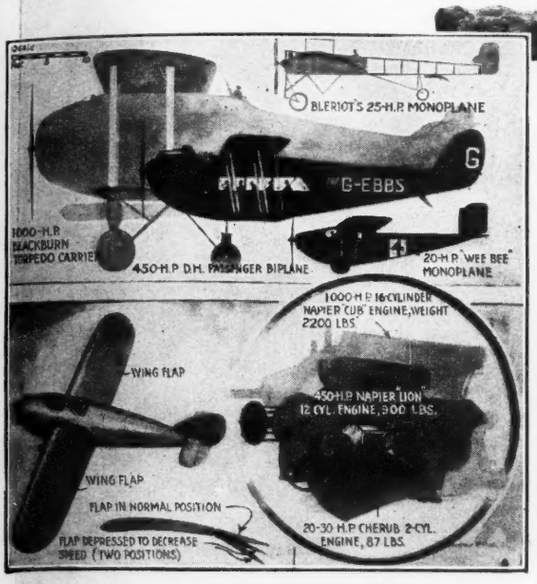
The eight-passenger Fokker plane shown below is in daily service between Amsterdam and London and Amsterdam and Paris. It also is used to carry the Royal Dutch Air Mail. Pilot and navigator ride in front in an outside cockpit



Ten-passenger plane of all-metal construction developed by Claude Dornier, a Zeppelin engineer. All wood and fabric has been replaced by duralumin

One American company operates 46 air taxis in its district. Another with 11 planes has terminals at New York, Key West, Miami, Havana, Detroit and Cleveland. London dwarfs all with 16 distinct and independent air lines to all parts of Europe.

But London may lose this prestige before long. Chicago and Dayton promoters are organizing a Yellow Air Taxicab Company to build aerial cabs and operate them between Chicago, Cleveland, Detroit, Boston, New York, and Washington, maintaining regular schedules, as well as special trips, and with connections at all points. The cabs


BLERIOT'S 25-H.P. MONOPLANE
G-EBBS
1000-H.P. BLACKBURN TORPEDO CARRIER
450-H.P. D.H. PASSENGER BIPLANE
20-H.P. WEE BEE MONOPLANE
1000 H.P. 16-CYLINDER NAPIER 'CUB' ENGINE, WEIGHT 2200 LBS.
WING FLAP
450-H.P. NAPIER 'LION' 12 CYL. ENGINE, 900 LBS.
WING FLAP
FLAP IN NORMAL POSITION
FLAP DEPRESSED TO DECREASE SPEED (TWO POSITIONS)
20-30 H.P. CHERUB 2-CYL. ENGINE, 87 LBS.

will be equipped with air meters that will clock the air miles and in other respects will be strikingly similar to the land taxis. By this system, the organizers say, a man can cover the northeastern section of the country in a day or two, a task that now would take months.

IN FRANCE, likewise, commuters are taking to the air. Four Paris business men recently joined in hiring planes to transport them daily from their homes in the Auteuil district at the southwest of the city, to the factory district near St. Denis on the northeast side. Where formerly it tpok them two hours to cross the city, they now make the trip in about 10 minutes.

In the last three years more than 300,000 flights have been made in the United States. The mileage flown is estimated at the incredible total of 18,000,000 miles; the number of passengers at 600,000. Out in the Pacific Northwest some 2500 persons traveled in hired airplanes last year. Business trips from Peoria and Bloomfield, Ill., were made into Chicago and St. Louis in air taxis by 1500 people during the same time.

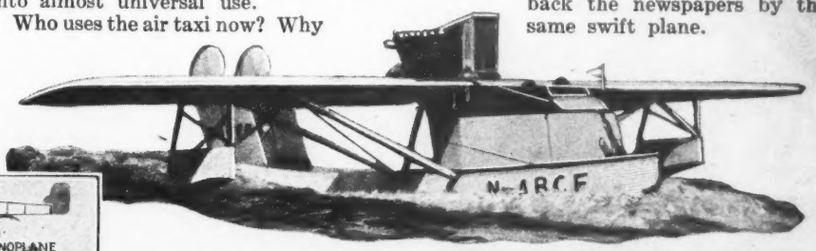
The chief value of these statistics is that they make a picture. They show how rapidly this new vehicle has come into almost universal use.

Who uses the air taxi now? Why are all these daredevils willing to risk their lives in the birdman's frail craft?

Take the first question. A friend of mine answered it in Los Angeles last year. "I can't go to Catalina!" he wailed. "And I've longed to for years." Pressed for explanation, he added: "I haven't the time; and a sea trip annihilates my insides!"

Entered a third party at this moment. "Come with me," he said mysteriously. He called a chauffeur. By motor we reached the airdrome dock. Protesting, but pleased, my friend climbed into the waiting seaplane. For $12 he was swung across to the beautiful island in half the boat time. He suffered no seasickness. And when I asked him if he were frightened, he said: "How could I be? We were never more than 20 feet above the water!"

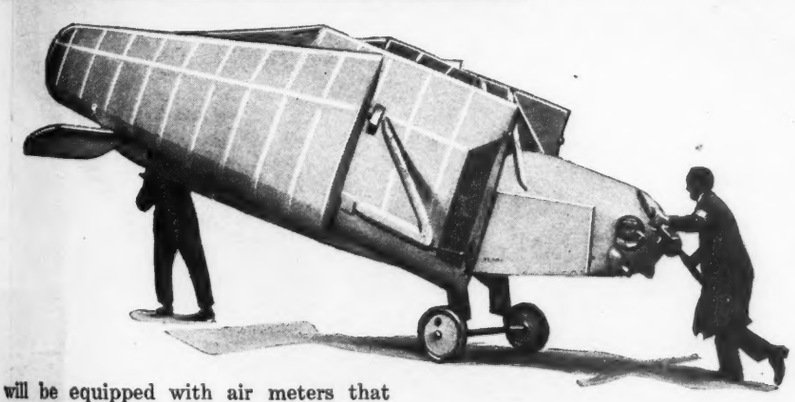
Briefly, the air taxi will serve those pressed for time and comfort. Time is the chief element. The commercial salesman uses the airplane to cut his overhead. The capitalist uses it to save the dollars his minutes are worth. The sportsman uses it to span the miles between office and field. The film company uses it to catapult precious photos from prize-fight to press, then to shoot back the newspapers by the same swift plane.



The speedy "air yacht" developed by Grover C. Loening for operation on a Newport-New York passenger airline proved so successful that a number of planes of the same model have been adopted by the U. S. Army. It carries a pilot and four passengers

Fit in Garage

A recent elimination flying contest in England for planes that could pass through a 10-foot gateway produced a number of amazing aerial "flivvers," some of them small enough to be housed in a back-yard garage. Among them was the "Wee Bee" (below), a 20-horsepower monoplane with folding wings. The diagram shows this machine beside a 450-horsepower passenger plane and a giant torpedo plane; also a comparison of engines. A new method of decreasing speed by means of wing flaps for landing in small space is shown at the lower left



Now the other question about risking one's life. You've heard the saying, "Figures don't lie." They don't, at least with regard to the rapidly improving safety of air travel. The French have the most extensive records on commercial travel. In 1923 their companies sent planes out on 9270 trips, covering 2,104,700 miles. The total number of passengers carried was 11,638. And the grand total of accidents for this entire period was *six!*

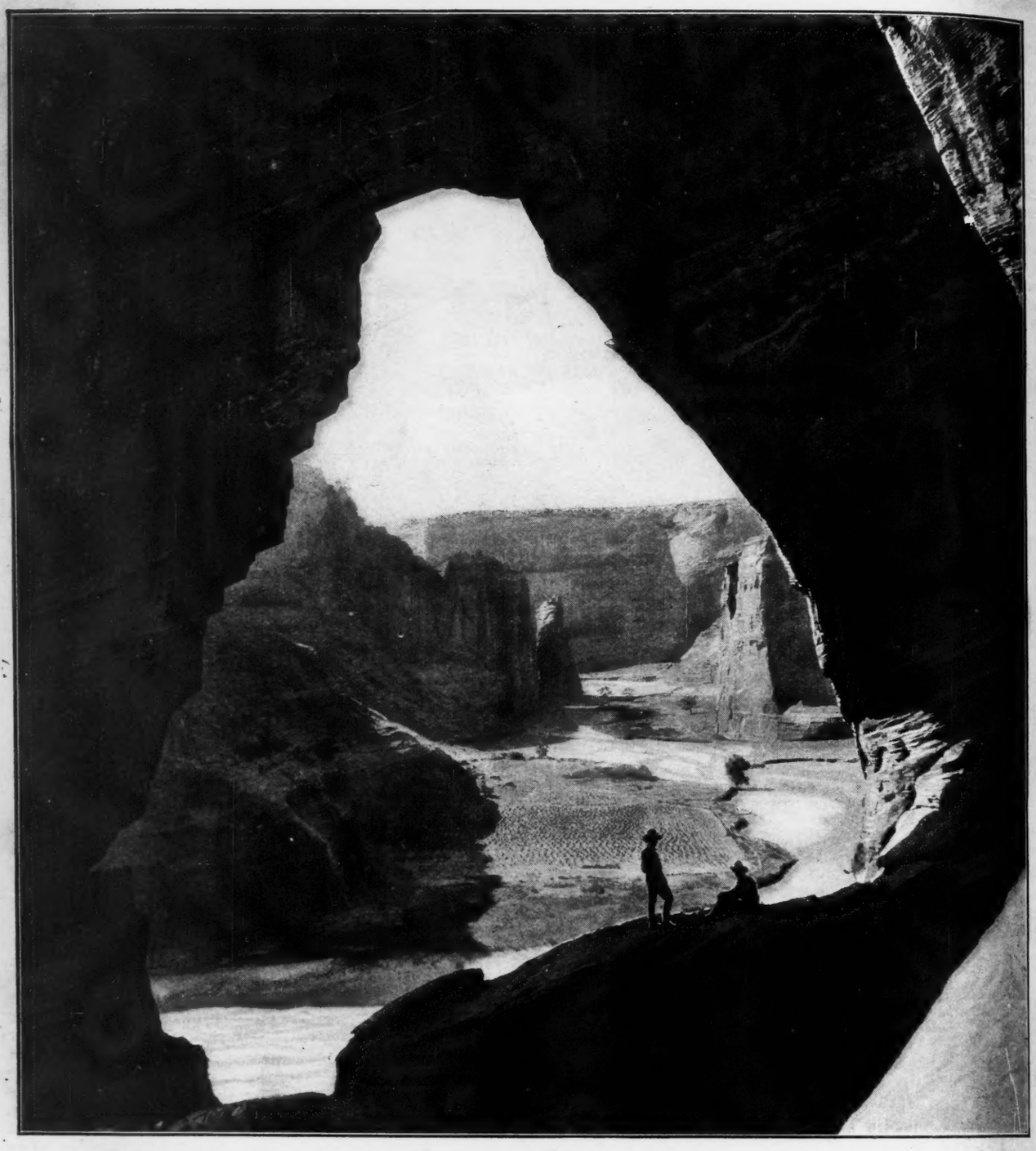
ONE of America's leading commercial fliers declares that in seven years of flying, during which he has taken up thousands of trusting passengers, he never has had a single accident. "Ten times as safe as an automobile!" he declares. Like others, he points out that most of the tragedies we hear of are those due to stunt flying, or are the result of special tests by experts in the interests of the progress of the science.

Devices for making commercial flying foolproof are being developed rapidly. The plane parachute is one of the latest. Folded snugly against the wings is a large umbrella-like silk bag with leading lines to the fuselage. Inclosed springs throw this parachute clear. To lighten the total weight, the engine and radiator can be released by the pilot. Thus, in emergency, such as engine-stall or broken wing, the plane with its passengers can float lightly down to earth with the same safety the ordinary parachute jumper enjoys.

HELICOPTER attachments also help. A helicopter, you know, is just an airship with propellers in a horizontal plane that lift instead of pull. As a safety device the helicopter propellers permit the plane to hover when landing.

Taking-off also will be much safer. Most airplane accidents occur in the first thousand feet before the pilot has height enough to enable him to volplane to a safe landing in case his engine goes dead. A plane with horizontal propellers to lift it need do no flying whatever until a safe altitude is attained. The performance will be similar to that of any elevator. The *pulling* propellers will be started only after the machine is well aloft.

(*Continued on page 166*)



Cliffs that Once Were Sand-Dunes

Scientists Find Marks of Ancient Desert on Arizona Rocks

THE past history of the earth has included, geologists are now discovering, extended periods of desert climate, as well as the Ice Ages that long have been recognized. One of the regions that shows most clearly the evidences of desert conditions is the part of northern Arizona where is located the famous Canyon de Chelly (pronounced "Shay"), shown in this unusual photograph.

The rocks of this region are great masses of red and yellow sandstone, through which a long-vanished river has cut the deep gash that now is the canyon. The thin layers of the sandstone, some of which can be seen in the rock surrounding the arched opening in the foreground, frequently contain ripple-marks made by the wind on the surface of desert sand-dunes millions of years ago, when these rocks were being formed.

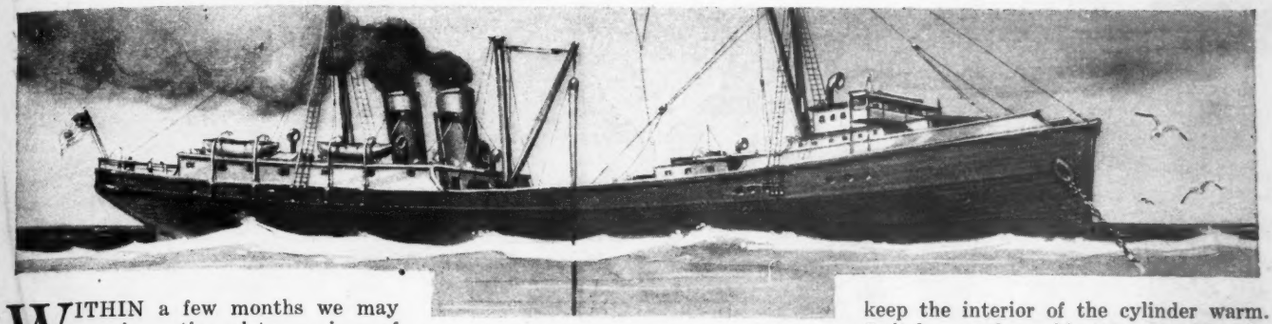
In other places appear tiny depressions made by the raindrops of desert showers that fell in that long distant past.

These ripples and rain marks were buried by new layers of wind-blown sand before they could be erased. In the course of many millenniums they hardened into rock.

In these canyons, too, there lived some centuries ago tribes of cliff-dwelling Indians. Ancient dwellings still can be seen in niches on the high walls. Scientists believe the climate has become drier since then, for the rainfall now is insufficient to support more than a very few families scattered here and there where springs or seepages provide water for a primitive sort of agriculture.

Diver to "Shoot" Deep-Sea Movies

New Submarine Camera Will Photograph Sunken City



WITHIN a few months we may see in motion pictures views of magnificent ruins and treasures that have been buried since the dawn of history at the bottom of the Mediterranean Sea. These wonders of a vanished civilization may be brought before our eyes as a result of the invention of a remarkable motor-driven submarine camera, which takes both still and motion pictures at depths as low as 2000 feet.

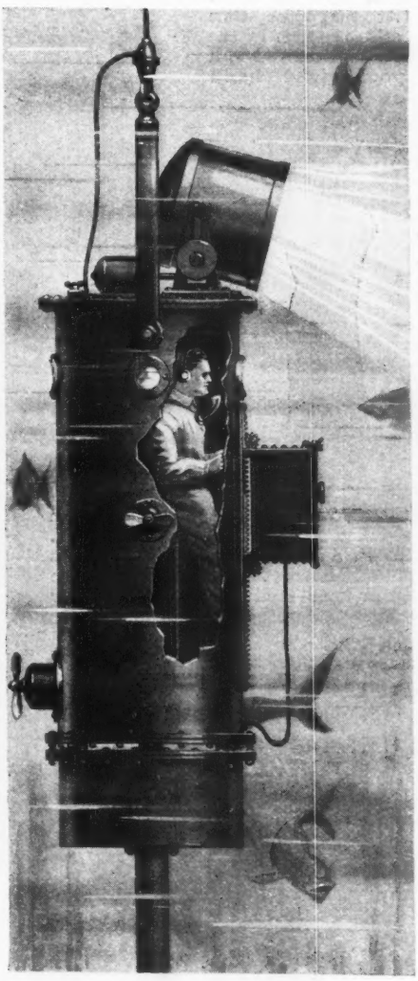
This camera is to be used for the first time on an expedition setting forth from the United States this spring. American, French, and English scientists, under the leadership of Count Byron Kuhn de Prorok, a French archeologist, best known as the excavator of ancient Carthage, are going to the coast of North Africa, where they intend to photograph a sunken Roman city, recently discovered at the bottom of the sea. They also expect to salvage treasures of tremendous value. The clearness of the water in the Mediterranean, where in many places it is possible to distinguish objects 100 feet below the surface, makes it ideal for taking submarine pictures.

Doctor Hans Hartman, inventor of the automatic camera, an electrical engineer of New York City, and an expert in submarine research, will supervise the filming of the ruins. He is known as the inventor of an automatic deep-sea camera, described in POPULAR SCIENCE MONTHLY, in October, 1917. With this, in great depths, he took numbers of pictures for the U. S. Government.

THIS camera, however, was controlled from above the water and pictures had to be taken without knowing what was being photographed. Doctor Hartman's new camera enables the operator to go down into the water with a camera and photograph whatever he chooses.

The apparatus consists, essentially, of three parts, one above the other, suspended from a ship by a steel cable. The operator rides in the middle of the apparatus on a saddle within a steel cylinder 32 inches in diameter. Small portholes, closed with heavy lenses, enable him to observe the water surroundings. He enters the cylinder through a large porthole on top. By means of telephone communication with assistants above the water, he may direct salvaging operations, carried out with auxiliary apparatus, as well as take pictures.

The operator at no time is affected by the tremendous pressure of the water at great depths. An oxygen device renews the air within the cylinder, while the carbon dioxide he exhales is absorbed by another apparatus. In great depths, where the cold is intense, electric heaters keep the interior of the cylinder warm. Switches and pushbuttons enable the operator to control every part of the apparatus electrically.



The Camera Man of the Sea

With this newly invented undersea camera, an expedition of scientists this spring hopes to make motion pictures of a sunken Roman city in the Mediterranean. The operator is lowered from a ship in an armored cylinder, from which he operates the camera and a powerful light projector. Note the small motor-driven propellers by which the position and direction of the cylinder are controlled

A small watertight compartment outside the operating cylinder contains the camera. It slides up and down a double rail and is controlled by means of a small electric motor. The operator takes pictures by pressing buttons on a switchboard in the interior of the cylinder.

AT THE rear of the large cylinder, near the bottom, is a small propeller driven by an electric motor. This keeps the apparatus moving forward with the ship instead of dragging against the resistance of the water. When the mother vessel is not moving, operation of this propeller makes the cylinder assume an angular position, valuable for taking certain views of submerged objects.

Two smaller motors and propellers are provided on each side of the cylinder near its center. These also will move the apparatus forward or rotate it around its vertical axis. Thus the operator can turn with the camera in any direction, or incline the camera, with the entire structure, at an upward or downward angle.

Above the cylinder in which the operator rides is a powerful light projector. This has a motor-driven movement by which it can be swung vertically within an angle of 90 degrees, thus permitting a beam of light to be directed at an angle within 45 degrees, either up or down. Water-cooled mercury-quartz burners are arranged to reflect a flood of light with high chemical reaction upon the object to be photographed. Current for the light comes from above the water by means of a cable.

TO MAKE the objects stand out clearly in submarine photography, Doctor Hartman has devised an artificial screen or background. This is made by filtering a chemical fluid into the water from above. It reflects the artificial light, which otherwise would be lost in the dark distances of the sea.

The third part of the apparatus is a short cylinder suspended electromagnetically below the main steel cylinder. This contains storage batteries for driving the motors and overcomes the buoyancy of the structure, making it sink to desired locations.

The films made on the ocean floor will be developed on the mother ship.

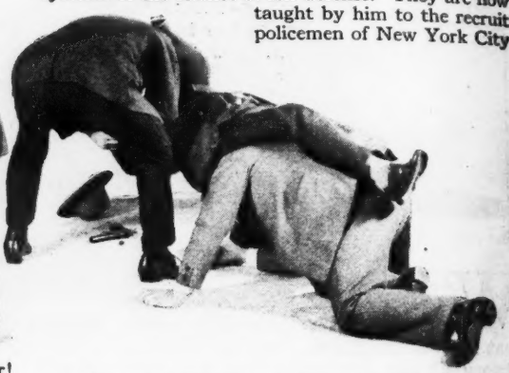
Eight Effective Tricks to Use if You Are Attacked

A New System

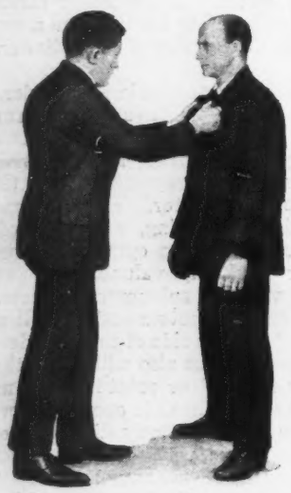
THE amazing tricks pictured on these pages were developed by Mr. Frantzen after long study of the jiu jitsu of Japan and other Oriental systems of the science of self-defense. They are now taught by him to the recruit policemen of New York City

If a highwayman suddenly covers you with a revolver while his companion seizes you from behind, it is best, probably, to obey and "Put up your hands!"

Don't keep them up, however! Bring the left arm down smartly, striking the wrist of the man holding the gun with the side of your open hand. This will knock the gun from his hand. At the same time seize the arm of the man behind you with your right hand



Then bend over swiftly, turning your body to the left and stepping forward with your right foot. At the same time bring up your left hand and seize the left arm of the man at the rear. The leverage of your body will hurl the latter over your shoulder and his falling body serves as a club to bring down his companion



If any one seizes you by the throat, or by the lapels of the coat, your defense is simple, as shown in the next picture

Clasp your hands and bring them down smartly about your assailant's neck. This will cause him to bend forward, as shown above. At the same time raise either knee—and the fight will be over

This system of self-defense is suited admirably to women who are forced to go unescorted into lonely or dangerous places. In the trick shown above, the heel of the hand is thrust against the attacker's chin, while the fingers are pressed between his upper lip and nose. Pain forces him to release his grip

Here is an effective defense against attack by knife, club, or fist. First, seize your assailant's wrist in a tight grip with your left hand, as shown

Bring your right arm about the inside of his, seizing your own left wrist, as shown in the picture, and pushing backward steadily with all your might

No matter how strong your assailant may be, he is forced to drop his weapon, to bend backward and fall helpless to the ground. If he resists, his arm will be broken by the leverage of your grip

# of Self-Defense

Posed Especially for POPULAR SCIENCE MONTHLY by William Frantzen

Inventor of the System, which He Has Taught Police of America and Europe

BY THE utilization of scientific principles of leverage, this system enables the small, light man or woman to resist successfully the most savage attacks made by heavier, stronger persons. Mr. Frantzen is slight, yet he has vanquished giants

In the above and the succeeding two pictures Frantzen demonstrates how you can perform one of his best tricks. Hurled to the ground, and with a strong, heavy man kneeling on your chest and choking you, it would seem that you would be helpless. Yet by a few slight movements and the application of force at the proper time and place, not only can you free yourself, but in addition you can render your assailant incapable of movement

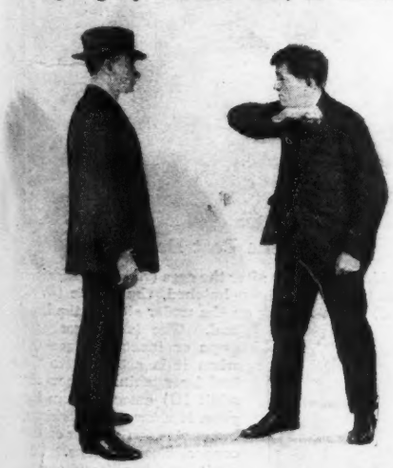
Seize the other's right wrist with your left hand and his right arm above the elbow. Apply a twisting motion to the wrist and also push outward on the arm

Once again leverage, applied at the proper place, will force your assailant to give way. The pain caused by the twisting of his arm makes him release his grip on your throat and involuntarily fall back in the direction in which you are exerting pressure. Continuing to twist, you force him always backward until at last he falls across your body and at right angles to it. Then it is a simple matter to seize him between your legs, and hold him in a firm grip until help arrives

Another trick peculiarly suited to women. Slip quickly behind your assailant, seizing him around the neck with your left arm while with your right grasp his left arm, as shown

If you are suddenly attacked on the street, an easy way to defend yourself is to kick your assailant's leg behind the knee with your heel and push against his chest with your open hand

Simple though this trick may seem, it is most effective if performed correctly. The kick behind the leg causes the other's knees to give way, while the push on his chest, delivered at the same time, throws him off balance. Try it, but be sure to supply your sparring partner with a soft place to fall



Here Frantzen demonstrates another simple way to protect yourself against attack which will prove effective against an armed enemy as well as against an unarmed one. The assailant is shown at the right of the picture with his arm poised to strike

As the other rushes at you, seize his wrist and upper arm, pushing upward on the former and downward on the latter with all your strength. Continued pressure finally forces him down

This is in effect a variation of the familiar "hammerlock" of the wrestler. The strongest person is quite helpless under this hold if it is applied with sufficient strength and quickness. The police find this trick particularly effective in overcoming an unruly prisoner, for it renders him helpless

Motorized Sleigh Skims Yukon Ice

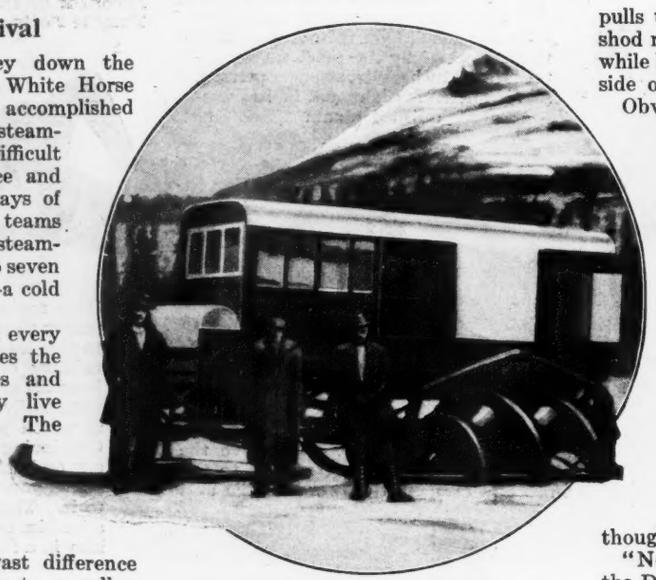
Ingenious Spiral Propeller Devised to Replace Dog Teams

By C. G. Percival

THE 450-mile journey down the Yukon River from White Horse to Dawson, Y.T., accomplished in summer by stern-paddle steamboats, becomes extremely difficult and expensive over the ice and snow of winter. Then relays of horse-drawn sleds and dog teams replace the swift-moving steamers, and it takes from five to seven days to complete the trip—a cold and tiresome journey.

Horse teams are changed every 22 miles, which necessitates the maintenance of 35 stables and rest stations, with costly live stock and large personnel. The item of feed for the horses alone is a staggering expense, for hay delivered at any point on the route costs $100 a ton. Impressed by the vast difference between gasoline at 22 cents a gallon and hay and grain at $100 a ton, employees in the shops of the White Horse & Yukon Railway built an ingenious motor-driven sleigh as a substitute for the conventional horse-drawn vehicle.

The only motor available was a 48-horsepower, four-cycle, four-cylinder engine with magneto ignition, four-speed sliding gear transmission and leather-faced, cone clutch, from an American automobile of the vintage of 1910. This was overhauled, mounted in a sleigh and connected with a screw propeller in the shape of an Archimedean spiral, placed beneath the sleigh and to one side, by chain and sprockets of exceedingly low gear.



The ingenious motor-propelled sleigh on Lake Le Barge, Y.T., between White Horse and Dawson City. Note the spiral screw

Turned by the motor, this propeller bites into the ice or the snow crust, and pulls the sleigh forward. A single steel-shod runner in front steers the odd craft, while long steel runners in the rear, at each side of the propeller, supply balance.

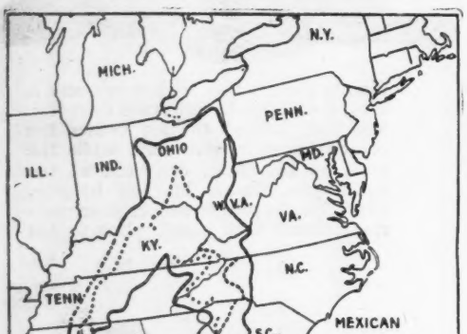
Obviously in soft snow the motor-sleigh would be practically useless, for the propeller would merely discharge the snow at the rear without causing the sleigh to move. But on ice, or on snow that possesses a strong crust, the sleigh and its laden trailer move at about 10 miles an hour.

American engineers, commenting on the motorized sleigh, expressed the opinion that the device was ingenious mechanically and possessed inventive possibilities, but raised the question whether such a screw device would prove more effective than a caterpillar tractor that would operate over soft snow as well as ice, though possibly not at equal speed.

"No doubt," said Carlos de Zafra, of the Department of Mechanical Engineering, New York University, "continued experiment will disclose the best pitch of screw for average conditions, minimum of weight for a desired tractive force, as well as maximum hauling capacity beyond which slippage of the screw on the ice would be excessive, also a method of flexible mounting to facilitate steering.

"The device seems deserving of development along lines that the peculiar local conditions would dictate."

Invading Mexican Bean Beetles Spread Destruction



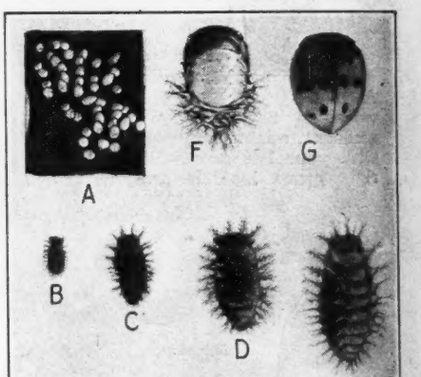
The Invasion

This map shows how the ravaging bean beetles have spread northward and eastward from Alabama since 1920. By 1921 the invaded area had increased sixfold, extending into Georgia and Tennessee. In 1922 the invasion was carried into Kentucky and the Carolinas, and in the next year pushed northward into Ohio. The pests in 1924 reached Lake Erie. This is the third insect immigration from Mexico, the other invaders being the boll weevil and potato beetle

DESTROYING great fields of beans before them, hordes of bean beetles from Mexico have been advancing steadily northeastward through the United States during the last four summers. The pests were first reported in the East in 1920. Since then they have reached the shores of Lake Erie and the Atlantic seaboard states.

The bean beetle closely resembles the inoffensive ladybird beetle of the same family. It is copper colored, about one-fourth of an inch long, with eight black spots on each wing cover. It feeds on the under surfaces of the bean leaves.

Arsenate poisons, sprayed under the leaves, offer the most effective means of combatting the pest.



How the Pest Develops

Within a few hours after the eggs (*A*) of the Mexican bean beetle have been hatched, the larvae (*B, C, D, E*) begin feeding on the under side of the bean leaf. The larva reaches a pupa or inactive stage (*F*) when it is attached to the leaf by a skin. When the adult (*G*) emerges from the pupa it shows no markings, but spots soon appear on the copper-colored wings. The adult attaches itself to the under side of the leaf where it eats ragged patches. Bean plants attacked by the beetle are left a fibrous network that shrivels in the sun. After destroying the foliage, the insect may attack the pods, and even the stems

For six weeks this great torrent of lava flowed silently down the side of Mt. Mauna Loa in Hawaii. Doctor Jaggar discovered during his observations that volcanic lava flows in tides, and that upon its movements depend the frequency of earthquakes

A New Way to Fame and Adventure

Noted volcanologist tells of thrills and opportunities to be found amid fiery craters at the edges of the world

By T. A. Jaggar, Ph.D.

DOCTOR JAGGAR is recognized as a leading authority on volcanoes. He is Scientific Director of the Hawaiian Volcano Research Association, in charge of the observatory at Kilauea volcano, maintained by the United States Weather Bureau.—THE EDITOR.

EXPERIENCE has taught me that when I meet new people I must be prepared to answer one or both of the following questions:

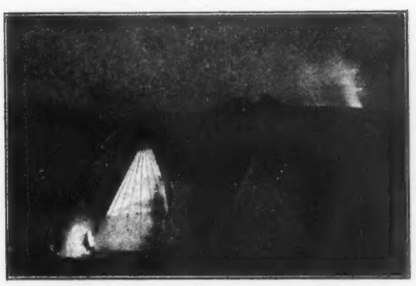
"Why do you study volcanoes?"

"Don't you find your work very dangerous?"

The answer to the first question cannot be given in a word or two. Volcanoes are studied because they are the most likely source of fundamental knowledge regarding the structure of the earth.

They are manifestations of the things that are within the earth, and consequently offer a way of peering beneath the earth's crust and solving its mysteries. Studying the interior of the earth through volcanic action requires the finest instruments of modern physics, and might be compared with the study of the insides of man by means of the X-rays.

There is another reason, too, why volcanoes are studied, and that is to learn as much as possible about their characteristics so that volcanic eruptions may be predicted and the world spared the frightful loss of life that has accompanied many volcanic disasters.



In the Glow of the Crater

Camped in cone tents on the high flank of Mauna Loa during the 1914 eruption, Doctor Jaggar and his fellow explorers could hear the rumbling and see the distant glow above the crater. The photograph shows their camp at night, illuminated by the glow of molten lava

THE second question that people ask me I can answer by a single word—"No." Despite the popular delusion to the contrary, volcano and earthquake lands are *not* dangerous. I have knocked about volcanoes for 30 years, walking to the innermost edges of craters, and climbing over hot lava flowing in a tunnel beneath me. I have felt earthquakes innumerable, of the volcanic and aftershock kinds. I have rushed post haste to disaster localities like a reporter to a fire. And yet, after living continuously for many years at the Hawaiian volcanoes, and after travels to 10 other regions where my job took me, I have to confess that never once have I felt particularly uneasy, nor found myself thrilled with the heroism pictured in the movies.

Of course, there are risks, but the most serious that I can recall were due to storm and exposure.

On a volcano called Korovinski, in Atka, in the Aleutian Islands, I was stormbound for two days in 1907 with one companion, in a little silk cone tent. The wind blew so hard we had to

The fire pit of Mt. Kilauea, brimming full of lava, as it appeared in March, 1921. The spectacular photograph was taken by Doctor Jaggar from a height a mile away

Spouting Fire

A marvelous nighttime photograph of a spouting lava vent on Mt. Kilauea. Doctor Jaggar set his camera up 25 feet from the fire-splashing cone and left the lens open for several minutes

take turns holding up the jointed tent pole all night. We struggled through the rain to a place of steam and boiling springs, and we saw volcanic cinder fresh on the snow. After two nights of this we shouldered our packs and set out for our schooner. The grass over which we walked was as slippery as the ice.

At last we came to a slope, flat at the bottom, but leading to a second slope that proved to be a precipice. Our idea was to slide down the first slope and stop at the bottom, but we had not realized how slippery the grass actually was.

I WENT first, slid all the way across the flat stretch, and shot into the air, shouting to my companion to dig his heels in and stop if he could. But there was no stopping. The drop was about 30 feet, and I landed in the middle of a deep pool of water along a stream course. A fraction of a second later my friend came hurtling through the air plump on top of me. Nobody was hurt, and we were already as wet as mortals could be.

Then we found the river was in flood, and had trouble getting across it and finding our food cache. After that there were miles and miles of soft marshy ground that went "squelch-squelch" underfoot. When we emerged at last at Nazan Bay and reached our schooner we were about the happiest and tiredest men alive.

That is a fair sample of the sort of adventures I've encountered while studying volcanoes. Whatever danger there was came not from the volcanoes themselves, but from cold, rain, and snow.

Of course, there is excitement and interest during a spectacular eruption such as that of Kilauea in 1919. To observe this we made bivouac all night at the foot of a line of fountains of fiery froth 200 feet high. These fountains would build up cones, and change location. The lava surged and sprayed like Roman candles.

About 3 A. M. came the climax, when fountains of bright orange incandescence lighted up the whole landscape and shot 400 feet into the air. Out of the glowing mass, which really was coming from a crack in the flank of the mountain, sped a network of lava streams that united in a steady river. This meandered away into the distance like a fiery Mississippi in a red hot flood plain. Over the brow of the mountain it went, and down through the forest 12 miles to the sea, where it poured under the ocean for six weeks.

We had to dodge the gas, and move back when the wind veered, and we were very weary and often wet and hungry. Now and then we ran into wild cattle, and occasionally I took a chance by

Kilauea's Lava Lake Rises and Falls

Fiery fountains splash at the edge of the liquid lava lake of Kilauea, which rises and falls rhythmically as though actuated by a tidal force. A view from the high rim of the crater's edge

clambering up a hot lava cone to photograph what was inside. But the sense of actually being in danger was not present, and nobody was hurt.

By far the most interesting experiences I ever have had with volcanoes began in 1919, when I began my investigations at Kilauea to ascertain whether the lava had a daily tide. Several young men volunteered to help me, and I set up a transit at the edge of the fiery lakes and made a camp there. The object was to read angles vertical and horizontal for a month every 20 minutes. We organized day and night shifts.

THE man who had to keep his eye at the transit between midnight and 6 A. M. had a somewhat spooky time, with hot, hard lava in motion beneath his feet, and the hot lake lava rising and sometimes overflowing in front of him. He had to watch the lanterns at the bench marks. All the transit readings at night had to be made with an electric torch. Sometimes there were earthquakes. The ground was tipping, so that the index error was rapidly changing and adjustments of level bubbles were called for frequently.

Twice we had to move the transit position. First because a wall of lava built up in front, and second because a flow came down by the shelter and things got too hot. Even in our new position the green wood posts of our shelter sometimes caught fire from the hot ground. My wife, who kept us supplied with food and cheer, one day dropped her gloves in the shelter. They fell across a crack and were soon afire.

WE FOUND there was a lava tide sure enough and the 20,000 observations of that month have yielded up secrets of Mother Earth that no one knew before. This discovery of regular movements in the Hawaiian lavas under the earth crust is being extended to quarterly and half-yearly phenomena shown by the charts of rise and fall. Upon the movements of the lava depend the frequencies of the earthquakes. All of this information has been compounded into a cycle about nine years long for Mauna Loa and Kilauea, robbing them of much of their ancient mystery.

In other words, when we know all about it, we may hope to predict pretty well what the volcanoes are going to do. And once the volcanoes are conquered, it is only a question of experience and experiment to apply similar reasoning to earthquakes.

As a matter of fact, even with the incomplete knowledge of volcanoes existing today, many volcanic eruptions can be predicted long enough before they occur to prevent loss of life, for volcanoes often give unmistakable

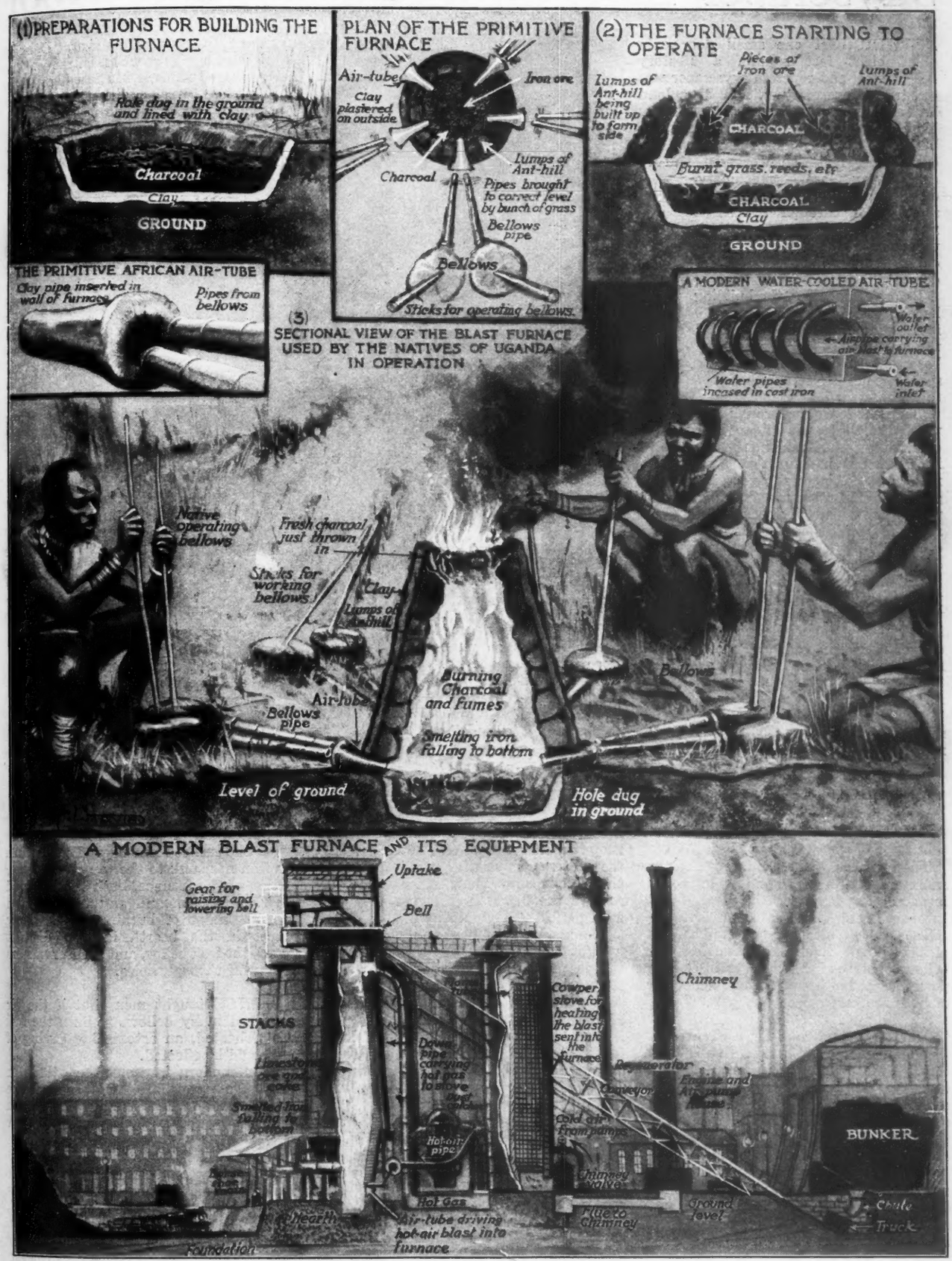
A Fountain of Slag

This gigantic slag fountain, 200 feet high, was found at the source of the Mauna Loa lava flow in October, 1919. To take this remarkable photograph, Doctor Jaggar rushed up the cone with his camera and stood within 50 feet of the rapidly falling fragments

forewarnings of their intentions a few days, and sometimes a few weeks, before an eruption. Even the great Mt. Pelee disaster at Martinique, one of the most

(Continued on page 168)

From Jungle Smelting Pit to Modern Blast Furnace



GREAT blast furnaces for smelting iron that loom up in our industrial cities, might be thought a development entirely of modern civilization. But, as a matter of fact, with all their immense size and marvelous machinery, their fundamental operation has been changed little since the dark ages. Tribes in the depths of Africa, where white men seldom have penetrated, are smelting iron today as their ancestors did for centuries; and in its essentials their method shows surprising similarity to the modern system. Both methods are pictured.

(Continued on page 56)

Skyscraper Built through Eight-Foot Door

THROUGH one small door only eight feet square, a 16-story steel-and-concrete skyscraper was constructed recently within the John Wanamaker department store in New York City, in making an addition to the building. To accomplish this surprising engineering feat the workmen had to carry every piece of machinery, every beam of lumber, and every steel girder through the single narrow opening. And they did it without disturbing business in the old building in the slightest degree!

Before remodeling, the building had a rotunda in the center, 60 feet square, which extended through the 16 floors from basement to dome. In this space the new skyscraper had to be erected.

The eight-foot door through which the thousands of tons of building material and hoisting machinery had to be carried was on the street level. Before beginning work on the new building, 18,000 wheelbarrow loads of wreckage and waste material from the rotunda had to be carried to the street through this same door.

Included in the material that was pushed through the eight-foot opening were eight elevator motors, each weighing eight tons, eight elevator generators of one ton each, 108,000 square feet of flooring planks, 9166 loads of hollow tile, 3000 bags of plaster, 6000 loads of floor arches, 1000 wheelbarrow loads of bricks, 1800 loads of ceiling material, 3000 scaffold planks, and 7000 feet of guide rails for eight elevators.

Shut off from the store by board partitions, the progress of the work was so unnoticed that when the new store-within-a-store was opened to the public, it was viewed with great surprise. Occasionally, during the construction, a customer discovered a door through this partition, but there always was the sign, "Danger! Keep out!" to check his entrance. The addition, which is 230 feet high, gives the store 51,200 additional square feet of floor space. While it bridges each floor, the structure is an independent unit, so that it would stand alone if necessary. The entire unit was completed in four months of work.

Workmen hauling one of the heavy steel girders for the 16-story skyscraper through the single eight-foot opening

A Sea-Going Foundry

ONE of the latest additions designed for the U. S. Navy is a floating foundry to be used for making major repairs and replacement castings for the ships of a battle fleet. This vessel, it is reported, will be one of a new group that will constitute the "works" of a fleet at rest or in motion. It is more than 400 feet long, of 70-foot beam, with 10,000 tons displacement, and includes a complete pattern shop and foundry and a multitude of other shops, all manned by a large force of mechanics. The total floor space available is nearly 5000 square feet.

Two cupola furnaces and four oil-burning crucible furnaces, all located on a third deck, constitute the melting equipment. The larger of the cupolas, with its stack, is some 60 feet high—high enough above the upper deck to allow the gases to blow clear.

Smelting—Old and New

(*Continued from page 55*)

The furnaces of the primitives and the enormous shafts of the most improved furnaces of today have the same shape. In each, an air blast is driven in to increase the heat, although the hand bellows of the jungle have been replaced by bellows operated by steam, gas, or electric power. Smelted iron drops to the bottom of both in exactly the same way.

THE African natives dig a circular pit about a foot deep and line it with clay. A three-inch layer of charcoal then usually is laid at the bottom and a fire started. This is fed with weeds and brush until there is a mass of red-hot ash in the pit. The men then build a wall around the pit, using lumps of ant-hill, and stick the blast pipes through the wall.

While some are building upward, others are putting a thick layer of charcoal on top of the ash at the bottom of the pit. Above this, close to the blast pipes, they place the iron ore, and over this more charcoal.

The pit is kept full of burning charcoal while the building is going on. The furnace is completed in from three to five minutes and the smelting begins. Squatting around the furnace, natives make their bellows go at full blast, and keep it up for four or five hours. When the natives think the ore is smelted, they knock down the furnace walls and remove the hot iron from the pit with a long stick.

The newest blast furnace consists of an upright cone set on top of an inverted one, just like those in the jungle. In size, of course, the modern furnace dwarfs the primitive one, its shaft usually towering 80 feet into the air.

The blast furnace of today is kept full of lumps of fuel, iron ore, and limestone, which are fed into the enormous shaft from the top. Trucks carry this mixed material up a track to the top of the furnace and drop it into a hopper.

THE mixture descends slowly as the bottom of the column is eaten away by the coke burning in the hearth. This coke is kept blazing by hot-air blast blown through *tuyères* or holes near the bottom of the hearth, just as in the African furnaces. The African *tuyères* made of clay have been replaced by ones of iron or bronze, cooled by a coil of water pipes.

As hot gases rush upward from the burning fuel, they remove oxygen from the iron at the top of the furnace, and the other minerals in the ore combine with the lime of the limestone and the ash of the fuel to form slag. By the time the iron has sunk to the top of the lower section of the furnace, both the iron and the slag have melted and trickle down through lumps of burning coke. They collect in the hearth in two distinct layers, the iron below, and at intervals are drawn off through holes.

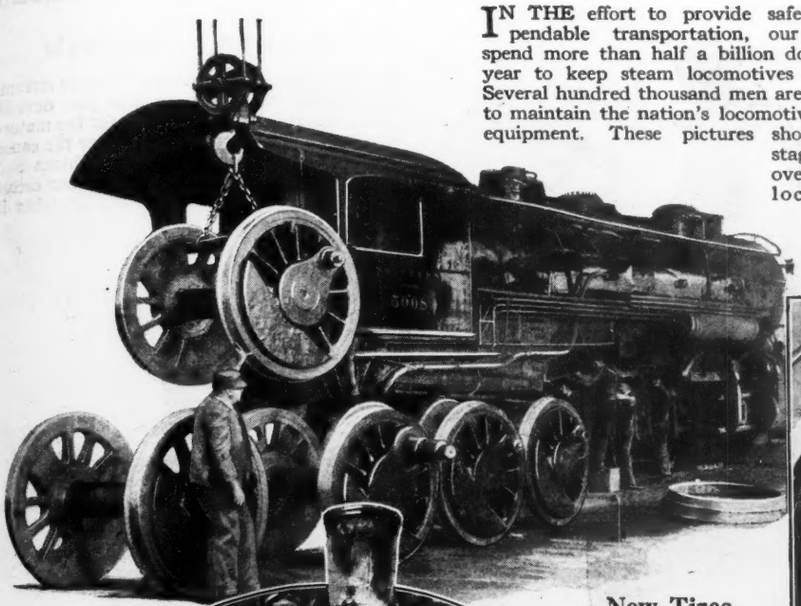
SCIENCE taught men that if the air forced in by bellows to burn the fuel was preheated, an astonishing saving of fuel could be effected.

So in modern iron smelting, three or four huge stoves are built around the blast furnace to heat the air blast. One of the most effective types is the Cowper stove. This contains in its interior several firebrick walls with spaces between. The waste gas from the top of the smelting furnace is conducted through a pipe to the stove, where it is burned, heating the bricks to a high temperature. Then the gas is turned off and the air blast run through and heated by the hot brick surfaces before going to the smelting furnace. Several stoves are used so that while the gas is turned on in one, air may be passing through another, thus keeping the blast hot at all times.

How Locomotives Are Kept Fit

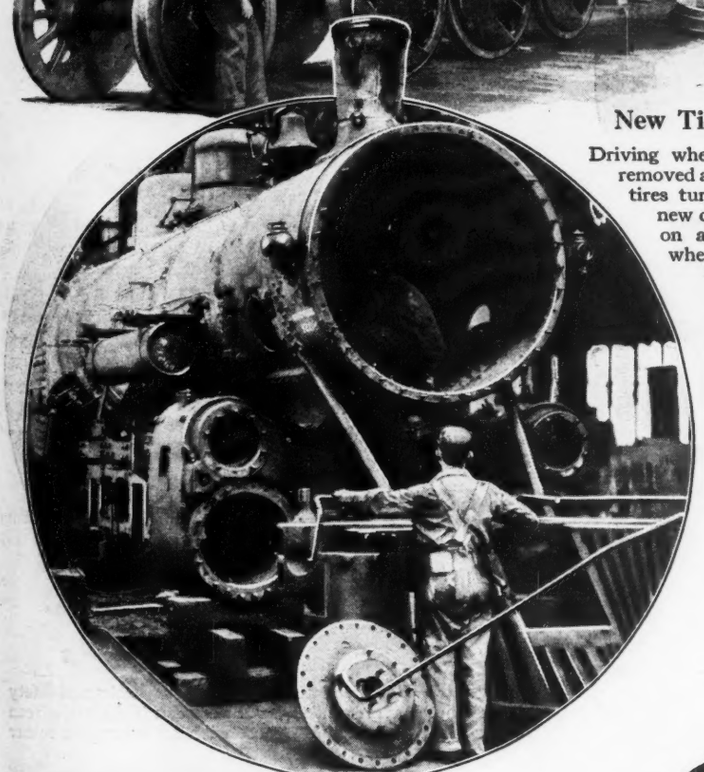
Millions Spent Each Year to Overhaul Giants of the Rails

IN THE effort to provide safe and dependable transportation, our railroads spend more than half a billion dollars each year to keep steam locomotives in repair. Several hundred thousand men are employed to maintain the nation's locomotive and car equipment. These pictures show various stages in the overhauling of locomotives



In the Smoke-Box

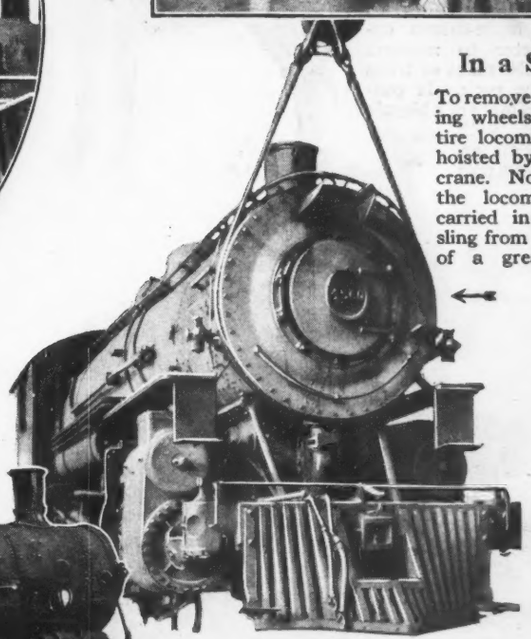
Once in every six months a locomotive requires a general overhauling. One of the hardest jobs is the renewal of flues, because of the narrow working space. The picture below shows railway men at work in the smoke-box



New Tires

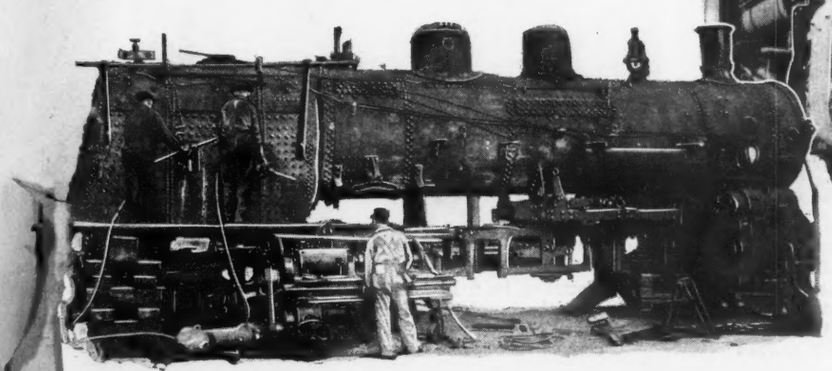
Driving wheels are removed and flat tires turned to new contour on a large wheel lathe

A general overhauling of the boiler and running gear is required to put this locomotive in good running condition. The smoke-box front has been removed and a workman may be seen inside



In a Sling

To remove the driving wheels, the entire locomotive is hoisted by a giant crane. Notice how the locomotive is carried in a cable sling from the hook of a great crane



← Renewing the Boiler

Supported on jacks, the locomotive at the left is undergoing a general overhauling of the boiler and firebox, while waiting for a new set of tires. The two workmen seen at the rear are putting new staybolts in the firebox

Oddities from the

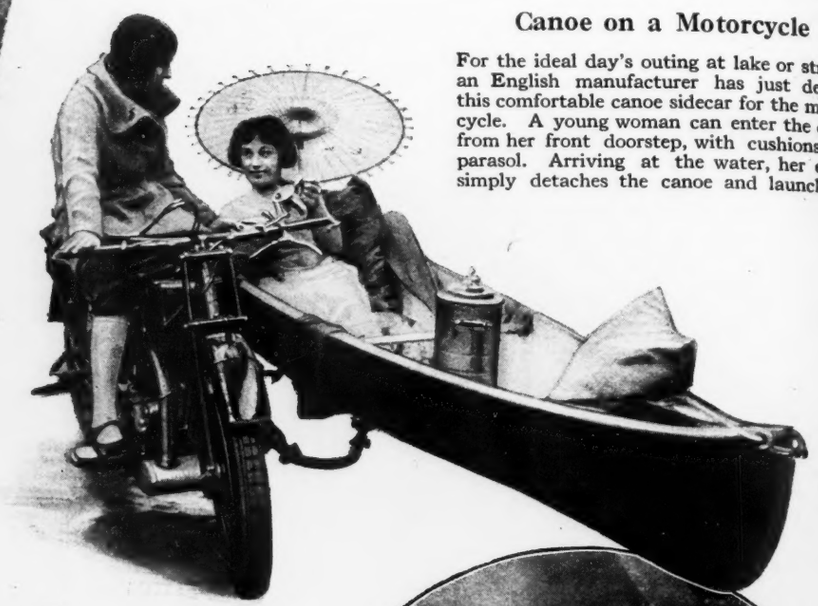
Queer Inventions and Original Ideas

Sailing in a Soap-Box

Most every boy has built a soap-box wagon, but how many have thought of attaching a sail? This lad of Sydney, Australia, did it with a sugar bag and a couple of sticks

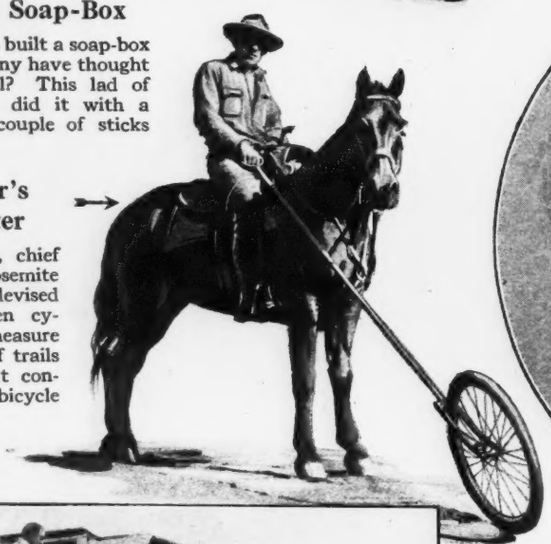
Canoe on a Motorcycle

For the ideal day's outing at lake or stream, an English manufacturer has just devised this comfortable canoe sidecar for the motorcycle. A young woman can enter the canoe from her front doorstep, with cushions and parasol. Arriving at the water, her escort simply detaches the canoe and launches it



A Forester's Cyclometer

E. C. Solinsky, chief forester of Yosemite National Park, devised this horse-driven cyclometer to measure the 600 miles of trails in the park. It consists simply of a bicycle wheel, with cyclometer, on a long pole



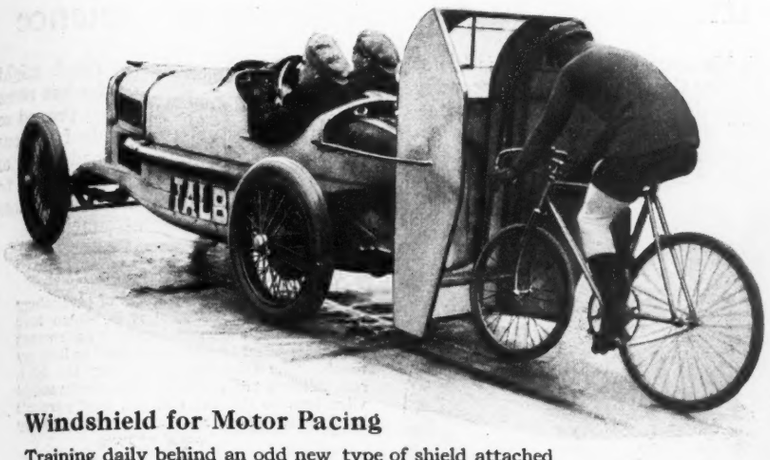
Rescued!—Equipped with improved gas masks and safety lights, a rescue crew of the U. S. Bureau of Mines is seen emerging from a burning mine with an overcome miner

Home in a Boat—When the cold winter months came, Charles McKown, of Winthrop, Mass., pulled his houseboat up on the shore of Boston Harbor. He added a storm door and weather strips for the windows, converting the three-room boat into a very comfortable home during the severe weather, high and dry above the incoming waves

Touring in a Log—E. C. Case, of Bellingham, Wash., recently completed this unique three-room home on wheels that once was part of a giant Douglas fir-tree. It boasts conveniences not always found in stationary houses

World's Scrapbook

Found Here and There by Camera Men



Windshield for Motor Pacing

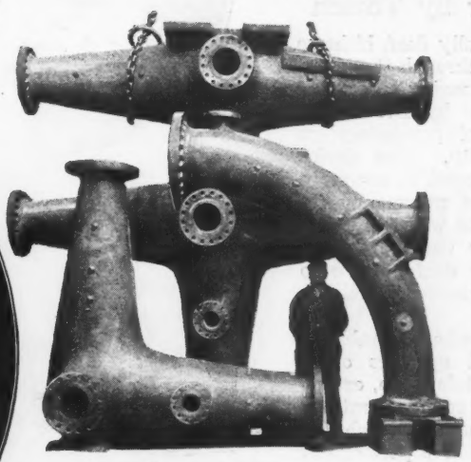
Training daily behind an odd new type of shield attached to a racing car, M. Miguel, one of the foremost cyclists of France, hopes to break the motor-paced cycling record

Bike of Sticks

An Englishman living at a distance from his work wanted a bicycle, and saw possibilities in a hedge fence near his home. In a short time he had completed this odd bicycle. It is built entirely of hedge sticks. Every day for years the inventor has been using his queer looking wheel, which still gives good service. The parts of the frame are arranged like those of an ordinary bicycle. Notice that a crotched stick serves as the fork for the wheels

Testing His Heart

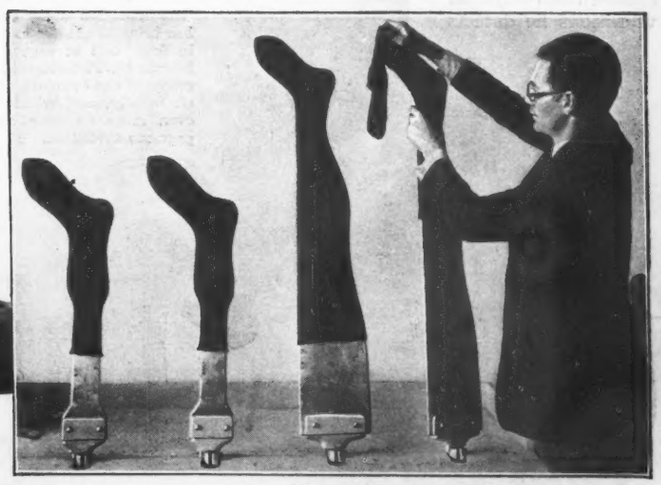
In a London veterinary hospital a spiral spring stethoscope recently was introduced to sound out the hearts of dogs that go in for treatment



Dwarfing a Man—These enormous cast-steel pipe fittings recently were turned out by a Chicago manufacturer. The fittings were made especially for use under 450-pound steam pressure in the main steam line of a Detroit, Mich., electric-light company

Wood Pipe Line 62 Years Old

While excavating in Seattle recently, workmen uncovered a pipe line of bored fir logs, a relic of pioneer days. It was part of the city's first water system, laid in 1863. Connection between logs was made by a wooden sleeve. Iron bands kept the logs from splitting



Testing Hosiery—To determine the relative merits of different brands, the Bureau of Standards has devised a method of stretching stockings over boards, where they are dried electrically. The hosiery previously is washed, dyed, dried, then washed again, to determine whether it will hold its shape and how long it will wear, and thus a standard is established

New Instrument Enables the Deaf to Hear with Their Hands

The Month's Useful Contributions to the Progress of Science

EVERY day the laboratory worker is discovering new secrets that will make human life healthier, richer, and happier. The explorer is pushing into the unknown and bringing back new facts about the world we live in. The inventor is creating new tools, machines, and methods to lighten labor and increase our comfort.

Science moves swiftly forward. Its record of achievement grows too vast for a busy world to grasp.

It is to help you keep step with new discovery that POPULAR SCIENCE MONTHLY publishes here a résumé of the month's important contributors to scientific progress.

The Deaf Hear by Touch

TO TEACH the totally deaf, hitherto incurable, to hear through the palms of their hands is the amazing purpose of an instrument invented by Dr. Robert H. Gault, professor of psychology at Northwestern University. The device has not yet been developed to the stage where it may be applied universally for the relief of deafness, but with the aid of the instrument Doctor Gault has succeeded in teaching five deaf persons to identify perfectly 15 sentences containing 90 one-syllable words.

The instrument somewhat resembles a telephone receiver and operates on a similar principle to the telephone, except that, instead of carrying sound vibrations to the ear, it causes them to reach the hand or some other sensitive part of the body. It is necessary, then, for the person using the apparatus to recognize what speech sounds caused the particular vibrations he detects through his sense of touch. This is not easy, Doctor Gault says, yet it is scarcely more difficult than is learning what similar combinations of vibrations mean when they fall upon the ears of normal persons.

Some time ago Doctor Gault conceived the idea that the sense of touch might possibly be substituted for the lost sense of hearing. His invention has proved so successful in actual use by deaf persons that Doctor Gault has obtained leave of absence from Northwestern University to perfect the apparatus under the auspices of the National Research Council.

Brings Hearing to the Deaf

Dr. Robert H. Gault, professor of psychology at Northwestern University, is shown here demonstrating the marvelous new instrument he has invented to enable the deaf to hear by touch. The receiving instrument (at left), resembling a telephone receiver, carries sound vibrations to the palm of the deaf person's hand or to some other sensitive part of the body

Improved Compass for Fliers

The invention of the earth inductor compass has brought greater safety to fliers in clouds, in fogs, and at night. Now the inventor, Morris M. Titterington, is at work on a new model of the compass, which will be operated electrically, and which, he believes, will be even more accurate and reliable than his previous invention. He is shown here working in his laboratory at Brooklyn, N. Y.

© Keystone

New Light on Hypnotism

THE hypnotist who causes another person to commit crimes for his benefit when under his spell is purely a fictional invention, according to a recent announcement of Doctor Delboeuf, a French physician, who is an expert on hypnotic influence. Experiments conducted by the French scientist show, he says, that persons when hypnotized will not perform acts that are repugnant to their conscious minds.

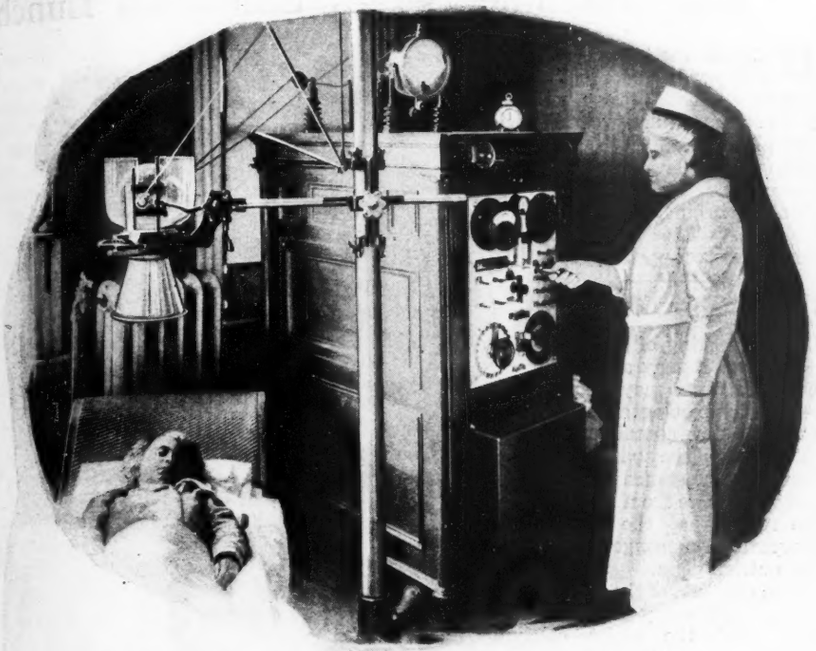
A subject whom he had hypnotized, Doctor Delboeuf asserts, when given a bottle, a stick, or some other harmless object and informed that it was a pistol, would "shoot" any person designated. If given a real pistol, though, even if unloaded, the subject would not pull the trigger when directed to use the weapon against any one.

A Foe of Disease Germs

AN AMAZING scientific achievement, one that may hold important possibilities, came recently when Dr. Robert

C. Green, assistant professor of bacteriology and immunology at the University of Minnesota, succeeded in isolating in disease bacteria cultures a mysterious substance believed to consist of exceedingly minute organisms that live as parasites on the disease germs. The substance, he claims, will kill the most deadly disease bacteria even when in a solution diluted a million times.

The discovery was made by filtering bacteria cultures of dysentery, typhoid, diphtheria and other infectious diseases through stone filters. The result was a clear white liquid that contained no disease germs. When added to a germ culture, one drop of the liquid killed and completely absorbed the bacteria it contained in a few hours. Even when diluted a million times, the substance still proved deadly to the germs. Several reasons are noted by Doctor Green for believing that the substance consists of tiny living things that prey on bacteria as bacteria prey on man.



X-Ray Treatment for Whooping Cough Proves Successful

To combat whooping cough, which causes nearly 10,000 deaths a year, the medical staff of the On Shore Department of the Boston Floating Hospital recently adopted X-ray treatment. The results were so effective that the new treatment is being tried by hospitals in New York, Chicago, San Francisco, and Montreal. From 15 to 20 per cent of 700 cases treated are said to have shown improvement within 24 hours. In the remaining cases, with the exception of two deaths of babies, the improvement was rapid. The photograph shows a child undergoing the new X-ray treatment in the Boston hospital

Attempts New Polar Flight

FROM France comes word of another projected airplane flight over the North Pole. This expedition, partly financed by the Government and partly by private interests, will be under the leadership of Jules De Payer, who was one of the first men to suggest the airplane as a vehicle suitable for arctic exploration. It may be recalled that De Payer planned a flight across the Pole in 1913, and had made a preliminary reconnaissance when the European war forced the abandonment of the project.

De Payer now announces his intention of starting early in the spring for Franz Josef Land from which the flight over the Pole will be attempted at the first favorable opportunity. The scheduled course is the same as that planned by Captain Amundsen.

Creating Motor Fuels

IN ENGLAND, France, and Germany, where the supply of oil is not plentiful as ours, chemists are busy searching for fuel substitutes, especially for gasoline, against the day, often predicted by geologists, when the world's store of petroleum will approach exhaustion.

From England recently came a report of a method worked out by scientists of the Department of Scientific and Industrial Research whereby, through low-temperature carbonization of coal, there is produced a gaseous fuel suitable for home or industrial use, an effective gasoline substitute for motors and a solid smokeless fuel that can be used as a substitute for coal.

In Germany, according to recent reports, there has been developed a process of manufacturing synthetic petroleum from powdered coal treated with hydrogen under high temperature and pressure. The resulting product, even if derived from low-grade lignite, it is said, is quite equal to natural petroleum for motor fuel.

An even more remarkable achievement is that credited to French engineers and chemists, who are said to have perfected a method of obtaining gasoline of higher heating efficiency than that obtained from petroleum, coal, wood, or any other carbon-bearing material. The process is said to produce gasoline at a cost of 12 cents a gallon, which is less than one-third the retail price for natural gasoline in France.

No Insect "Languages"?

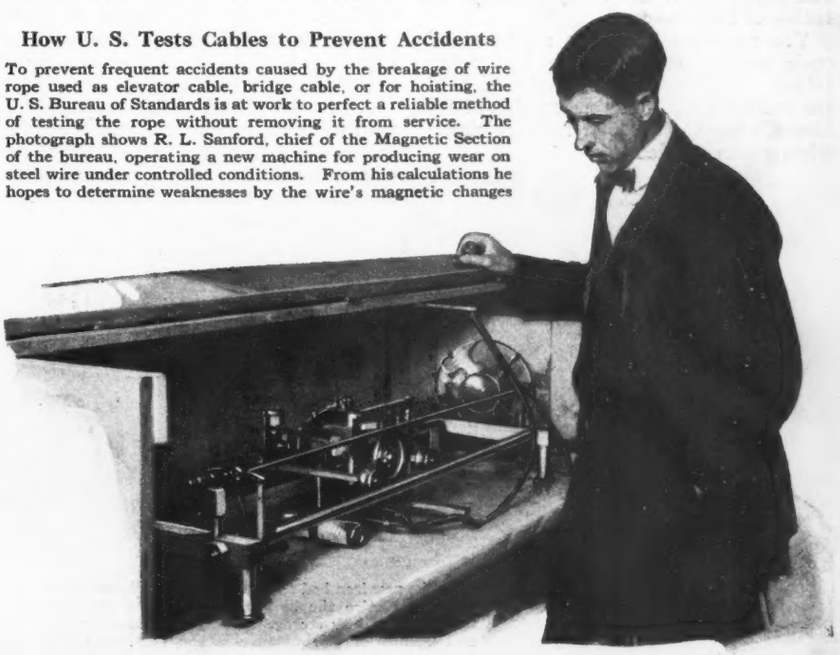
THE "voices" of insects always have been of peculiar interest to mankind. Many naturalists and entomologists have sought to interpret these sounds, and some have claimed to be able to distinguish between the battle cry of a cricket, say, and its love song.

Now comes Dr. Frank Lutz, curator of insects in the American Museum of Natural History, New York City, to assert his belief that the sounds of insects mean nothing—even to the insects themselves.

Insects squeak, buzz, or hum because their body conformation is such that they cannot help making a noise when they move, he thinks. The sounds they make, he says, probably are often embarrassing to them, just as the rattling of the armor of knights of old often betrayed their presence to their enemies.

How U. S. Tests Cables to Prevent Accidents

To prevent frequent accidents caused by the breakage of wire rope used as elevator cable, bridge cable, or for hoisting, the U. S. Bureau of Standards is at work to perfect a reliable method of testing the rope without removing it from service. The photograph shows R. L. Sanford, chief of the Magnetic Section of the bureau, operating a new machine for producing wear on steel wire under controlled conditions. From his calculations he hopes to determine weaknesses by the wire's magnetic changes



Handy New Kitchen Stool Is also a Stepladder

PLACED upside down, this convenient kitchen stool is a stepladder. The steps are covered with rubber mats to prevent slipping. The stool is finished in enamel.

Folding Iron Bed Invented for Small Apartments

WHEN extended, a new type of folding bed, invented by Reuben Haight of Hudson, New York, looks like an ordinary iron bedstead. By means of the hinged iron side supports, which extend from head to foot, the bed may be telescoped until it occupies only 18 inches of floor space.

The mattress is in two sections and each section fits into the bed when folded. Sufficient room remains to hold the bedclothing. The construction of the hinges prevents the bed from refolding when once extended.

How the new iron bed appears when folded and when opened. Notice the hinged side supports that fold upward; also how storage space is provided for the two sections of the mattress in the folded bedstead

How Many of These

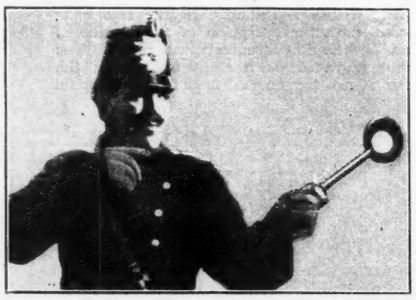
Slot Machine Serves Sandwich Lunch

DURING the too-short noon hour this newly invented automatic restaurant should prove popular. It is a container filled with sandwiches and pieces of pie. Drop a dime in a slot, pull a lever and you have your lunch, without standing in line, or tipping a waitress. The sandwiches and pie are wrapped in paper.

Clears Show Window

THE fogging of show windows, if they are of the boxed-in type, may be prevented by placing a flat glass or porcelain dish containing calcium chloride in the window. This chemical substance quickly absorbs moisture from the air, with the result that the moisture is prevented from congealing against the outside glass.

The contents of the dishes must be renewed every two or three days, and the moist calcium chloride thoroughly dried, after which it may be used again.



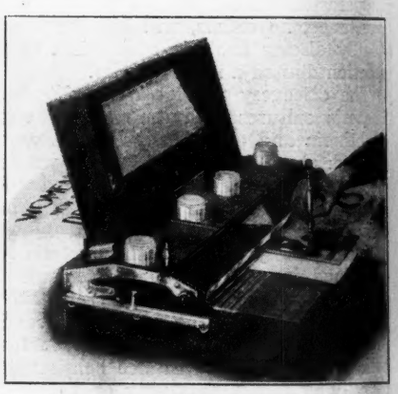
Disk Signal for Traffic

THIS German policeman regulates traffic at night by means of an illuminated disk. It is operated by an electric battery in his overcoat pocket.

A portable signal of this sort might be used to advantage on dangerous country crossroads where traffic is heavy, and where the lack of warning signals is the cause of many motor accidents.

Hand Lettering Made Easier by New Stencil Outfit

TO ENABLE draftsmen to do more perfect lettering in a fraction of the time ordinarily required to accomplish it freehand, a new type of stenciling outfit recently has been devised. Its use is said to give a more professional appearance to the work of amateurs who make occasional posters or sign cards.



Complete stencil outfit for lettering

The stencil is in the form of a rule from which geometrical figures have been cut. These are in shapes that are ample for forming various parts of printed letters.

New Aid to Naturalists—the "Telemagnifier"

THE latest instrument devised for use by naturalists in field study is known as the "telemagnifier." It combines the advantages of the magnifier or reading-glass, and the field-glass or telescope.

Ideas Can You Use?

Electric Grill in Living-Room Lamp

INVENTORS are doing their best to move the kitchen into the living-room. A novel method of doing this is in the form of a combination electric table-lamp and electric grill.

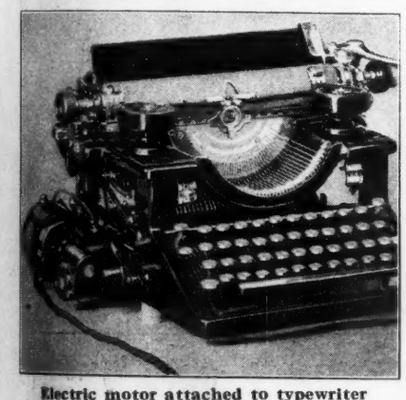
The grill is in the base of the lamp. Swinging the lamp pedestal to the right uncovers the grill and switches it on automatically, ready for use. The lamp remains lit if desired, or the lamp lights may be turned off while the grill is being used.

Anything that can be cooked on an ordinary small grill may be prepared on this one concealed in a lamp. It operates on a house-lighting current. It is especially useful in the nursery or sickroom.

TO PREVENT the rusting of metals used in construction, a New York manufacturer recently perfected a transparent liquid preservative that forms a tough, invisible, protective skin on the surface to which it is applied with a brush. This preservative is said to be proof against acid, salt water, and steam.

Electric Touch Improves Work of Typists

LESS fatigue for the typist and more and better work done are advantages claimed for a new electrically operated typewriter. The machine is operated in the same way as a manually operated typewriter, except that electricity, instead of the typist, provides the power for the key stroke. The typist presses slightly on each key and electricity completes the operation. Thus valuable human energy is saved.



Electric motor attached to typewriter

The 10-watt motor runs continuously when the machine is in operation. Back spacing and carriage return are accomplished by hand.

The uniform force with which each key is struck produces unusual uniformity of typing, and the action is said to be quicker and the touch lighter than on the ordinary machine.

This is said to be the first time that a standard American typewriter has adopted an electrical improvement.

Screws Driven by Hammer

HAMMER-DRIVEN screws are the latest time-savers for work in hard metal and composition materials. A hole of the correct size is drilled in the material. Into this the tip of the new type screw is inserted. As it is hammered, the screw cuts and twists into the material. The extreme hardness of the screw and the angle of its threads make it turn as it is driven.

The invention used as a rocker. To form a carriage the rockers are swung upward

Hand Rail for Stepladder Prevents Accidents

INSURANCE companies have computed the startling percentage of accidents occurring in homes. Not a small proportion of these are due to falls from stepladders.

A recent invention, a safety-first hand rail, which can be fixed to stepladders, recently has been designed to make them much less dangerous. The rail is movable and can be drawn up as the user mounts the steps. This provides a firm hold however high the user of the ladder may wish to ascend.

Baby Carriage, Rocker, and High Chair Combined

A BABY'S carriage, rocker, and high chair combined is the latest invention for the mother's convenience where floor space is limited.

To convert the invention from a rocker into a carriage, the rockers are pulled up at the rear to form a pushing handle. For a high chair, the same rockers, extended, form the support.

At the Motorcycle Rodeos

New Thrillers by Dare-Devil Bike Riders

"Ride 'Em, Cowboy!"

Perfect balance, combined with complete mastery of machinery, enable motorcyclists to perform these daring feats. At a motor-club rodeo in Camberley, England, not long ago, R. B. Rudd made a motorcycle jump of 36 feet. The camera caught him just before he landed

"Bareback" Riding

In a recent spectacular motorcycle meet at Tokyo, Japan, one of the riders stood on the seat of his speeding machine while rounding a turn in the racetrack

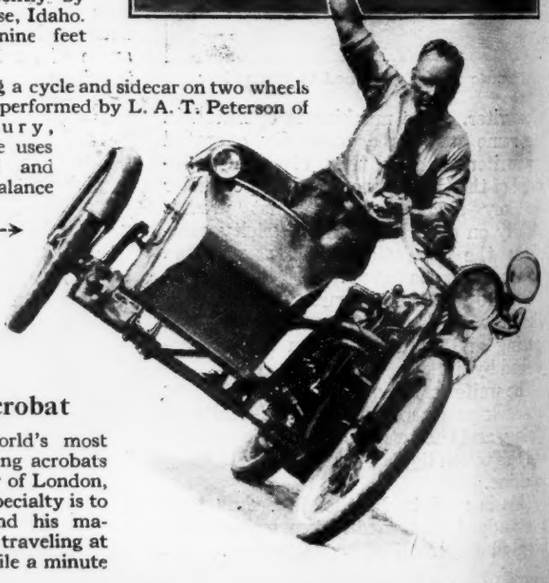
Human Ballast

One of many thrills in motorcycle races on the Isle of Man, England, a few months ago, came when G. S. Davison rounded a turn at terrific speed while his human ballast leaned far to the side to hold the little sidecar on the level

An 84-Foot Leap

A record-breaking leap of 84 feet was made recently by G. H. Stickler at Boise, Idaho. The machine rose nine feet

Balancing a cycle and sidecar on two wheels is the feat performed by L. A. T. Peterson of Waterbury, Conn. He uses one hand and arm to balance



Cycle Acrobat

One of the world's most skilful trick riding acrobats is Albert Milner of London, England. His specialty is to climb all around his machine while it is traveling at the rate of a mile a minute

Odd Ways to Go Boating

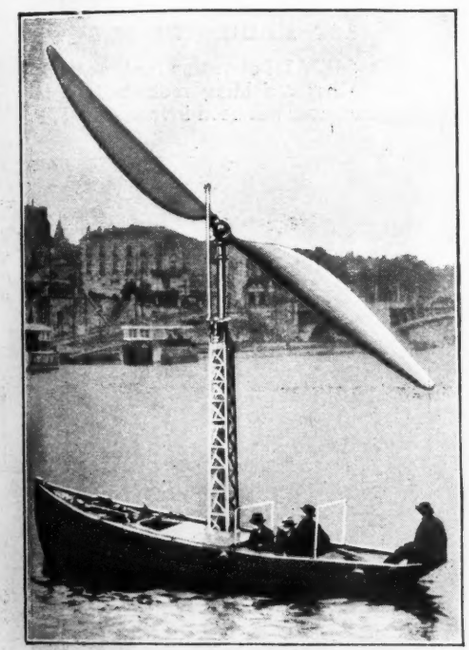
Unusual New Inventions for Water Travel

A New Skimming Boat

The remarkable speed of 55 miles an hour is claimed for this craft of the hydroplane type, designed in Glasgow, Scotland, to operate on the river Clyde. An airplane type engine drives the propeller. The hull is made in five sections

Bicycle Raft

A bicycle on pontoons, geared to a small propeller, travels six miles an hour when its inventor, Miss Zetta Hills, of London, pushes the pedals



Against the Wind

A boat built to sail against the wind and recently tested in Paris, has a 30-foot sail-like propeller, which drives a screw at the stern

Driven by Hand Lever

James E. Manvelle, of Wareham, Mass., has designed a boat that he can propel with one hand while he fishes with the other

For Sportsmen

A light, unsinkable rowboat for sportsmen, invented in Germany, is built of two small pontoons propelled by oars. It can be put together quickly →

Foot Paddles

This odd watercycle, designed by a French inventor, has pedals that operate fore and aft paddle boards. One paddle enters the water as the other leaves it. A speed of 10 miles an hour can be attained by this means of propulsion

A Picture Gallery

A Portable Lighting Plant

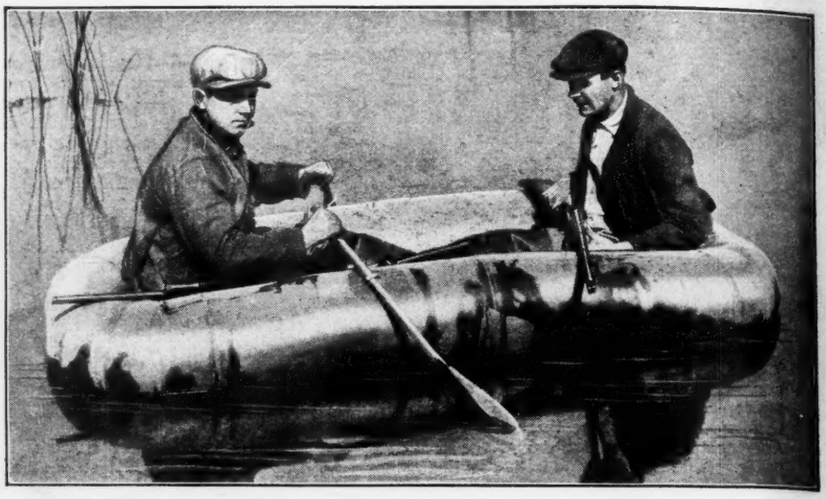
LIGHTING on the farm at a lower cost than the average city rate is promised by the manufacturers of a new automatic portable lighting outfit. The complete plant, exclusive of batteries, weighs only 125 pounds. A small gasoline engine charges the batteries whenever they become low.

The only attention needed is keeping the engine supplied with fuel.

A Round Whisk

WHISK brooms, ever since the first one was invented, have had shapes other than round. This new one, in which the round shape has been adopted, is said to be almost automatic in its soft action as it revolves in the hands of the user.

Portable Balloon Rowboat for Motorists



A FIVE-POUND unsinkable boat that may be carried under the arm or under an automobile seat, has proved highly successful in tests on Lake Keuka, N. Y. It is made of goldbeater's skin, such as is used in the construction of airships, and is built in four compartments.

Inflation of the new water raft takes only two minutes. It is especially practical for duck hunters or others who need boats but must travel light, as when several portages occur on a journey.

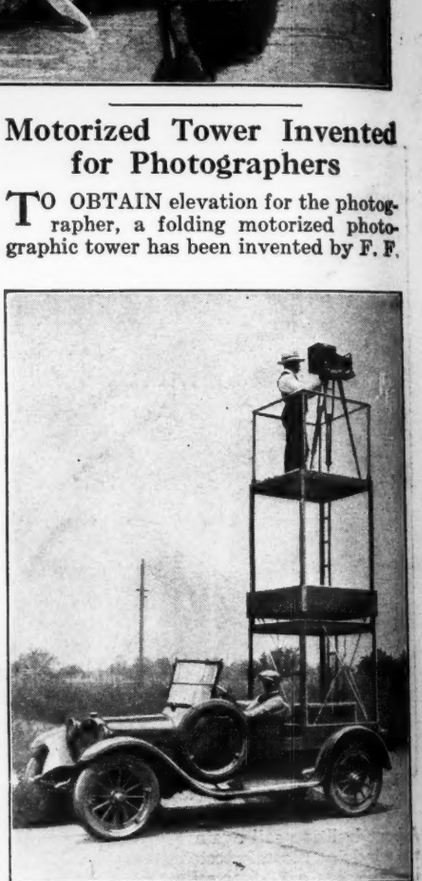
The World's Deepest Well

THE deepest well in the world was completed recently by engineers near Latrobe, Pa., when they struck natural gas at a depth of 7428 feet, or nearly 1½ miles. Work on the well was begun in 1922, and drilling continued for 30 months. The gas is now flowing at the rate of 500,000 cubic feet a day. It has a strong odor, like that of hydrogen sulphide, according to the engineers who constructed the well.

The total cost of sinking the well was about $200,000.

Motorized Tower Invented for Photographers

TO OBTAIN elevation for the photographer, a folding motorized photographic tower has been invented by F. F. Huddleston of Los Angeles, Calif. From it exceptionally fine pictures may be taken of street scenes, such as parades.



Making a photograph from the tower

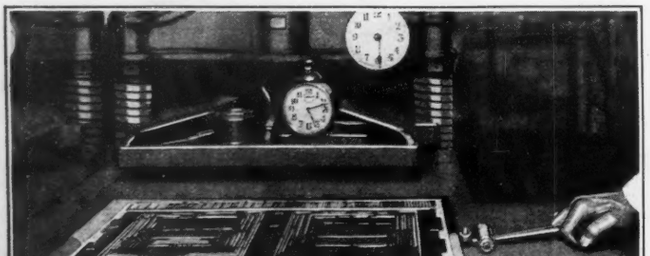
The tower is similar to those used by electricians for repairing trolley wires, but with certain modifications. To keep it from shaking and spoiling pictures, airplane bracing cables and turnbuckles are used in constructing the lower part of the tower. In addition, to eliminate spring action, a jack is placed under the truck while pictures are being made.

An ingenious crank-and-ratchet mechanism is used to raise and lower the tower. When driven through the streets, the tower is little higher than the top of the average covered motor-truck.

New Tool Aids Printers in Handling Forms

A NEW stereotyper's and printer's tool, for use in handling heavy chases or holding forms, is in reality a miniature truck, which can be inserted under one end of the chase in such a way that the weight is carried on rollers, facilitating handling by eliminating the great friction of sliding.

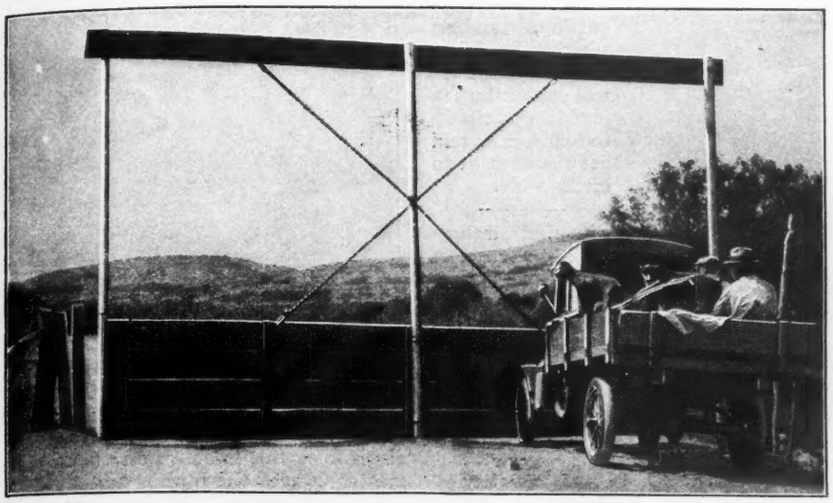
The tool consists of a long handle, two rollers, and a hook. It is operated by inserting this bluntly pointed end or hook in the recess in the chase that rests flat on the table. The tool is then drawn downward and backward, lifting one end of the chase and transferring its weight to the rollers. A really heavy weight can be lifted thus.



How the miniature truck carries the weight of a heavy chase

# of New Inventions

Western Ranch Gate Opens Automatically



IN THE Western ranching country where herds roam freely, "ranch gates" are found frequently across public roads. These highway barriers, which keep cattle or sheep in their proper section of the range, offer no inconvenience to the ranchers who know how to manage them.

If bumped properly with an automobile, a ranch gate opens automatically, without the driver having to get out of his car.

The gate is made of heavy lumber and is swung on an iron pipe in the middle of the road. A gentle bump by an automobile pushes it open, twisting the two crossed chains, shown in the photograph, around the pipe. After the car has passed through, these chains untwist and close the gate.

A tourist meeting these gates for the first time invariably has trouble. He either strikes the boards too slowly and kills his engine, or else dashes through and feels a resounding smack as the gate swings around too quickly and hits a rear fender. Only after many trials will he agree with the cattlemen that the gates are a convenience.

Portable Shop Is Shaped like a Cigarette

THE exterior of this ingenious shop in Berlin, Germany, one of the smallest in the world, is a clever advertisement for the dealer's wares. A tall metal cylinder represents a cigarette with the upper portion painted to represent a band. A small opening is cut in the center for a counter.

The cigarette salesman's stock is necessarily limited by space, but is renewed daily, and the whole shop is portable. It is set up by the street curbing and is moved according to the state of business.

French Plane Has Elevator

AN AIRPLANE fitted with an elevator is being constructed for the French army. It will be used by the gunner in charge of two batteries of machine guns, one at the top of the fuselage, and the other at the bottom. Thus he can pass from one battery to another, as desired.

Spectacle Opera Glasses

OPERA glasses used like spectacles end a long-standing annoyance of the theater. In this form the glasses are not easily dropped and the hands are left free and at ease.

The lenses of the new invention may be focused separately for each eye, an advantage to persons whose eyes differ in strength.

Easier Window-Cleaning

THE problem of how to clean the outside of a window is solved by a recently patented window, the sashes of which can be swung inward. An additional advantage is that both sashes can be opened at the same time, thus giving double ventilation and turning a bedroom into a real sleeping porch.

When installed, the swinging window resembles an ordinary double-hung sash window.

Stenographer Invents Handy Type-Cleaner

A SINGLE push of the typist's thumbs cleans all of the type on a typewriter without the use of cleaning liquids, by means of a new cleaner invented by a stenographer. The device is permanently attached.

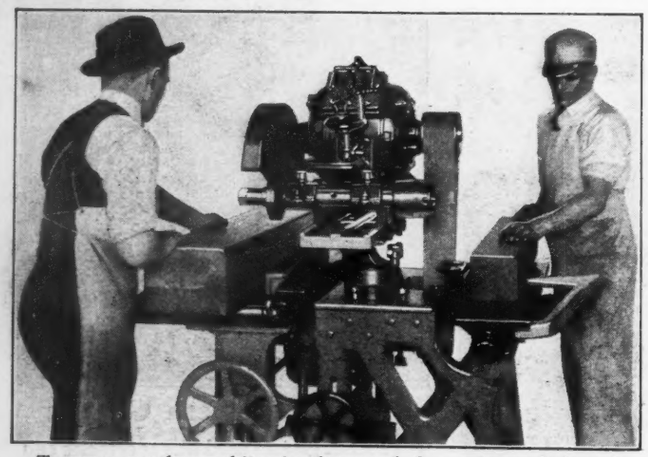
It consists of a brush shaped to fit the arc of type on most standard visible machines, and is contained in a stamped steel frame. To operate it, the stenographer presses the brush forward over the type. Pushing the cleaner 10 times a day keeps the type in first class condition.

Pushing the device with the thumbs automatically cleans the type

A Dozen Woodworking Machines Combined

HERE is a new woodworking machine that is said to combine 12 machines in one. It is electrically driven by a 4½-horsepower motor. It is built in four different sizes and is equipped with a tilting table.

Some of the many uses to which it is said to be quickly adapted are stair routing, jack-rafters cutting, sanding, plowing, molding, and mortising. It will cross cut up to four inches, rip up to four inches, and cut dadoes two inches wide.



Two men use the machine simultaneously for sawing and planing

THE first airplane to be shot successfully from an explosive catapult on a battleship, according to naval engineers, was hurled into the air recently at a speed of 55 miles an hour from the U.S.S. *Mississippi* at the Bremerton Navy Yard, Washington.

Although 14 pounds of smokeless powder was used to fire the plane from the forward turret of the battleship, it went on its way without noticeable jerk or shock.

Steel Mail-Safe Invented for Apartment Houses

PROVIDING security for the mail of apartment-house dwellers is this newly designed mailbox, which in reality is a steel safe in the wall. Unlike the old type of mailbox, this is built in a unit with a master door at the top for the postman, who has a key for it.

The lower, or individual doors are of sufficient height to accommodate magazines. The doors are nine inches high and each box is provided with individual lock and name-card holder.

New Electric Socket Wrench for Automobile Work

AN ELECTRIC reversible socket wrench, recently invented, is adapted particularly for assembling or disassembling automobile motors, and is proving a time-saver in service stations. Work can be done with it in a fraction of the time necessary for doing the job by hand, the inventor claims.

Driving bolts in auto-cylinder head

The spindle of the wrench is provided with a clutch that automatically releases when the pressure on the tool is relieved. Thus a nut, bolt, or stud may be driven to any desired tightness. For disassembling, a reversing switch is provided.

The machine is equipped with a quick-change chuck for holding different sizes of socket wrenches.

CHILDREN in darker sections of London are so starved for sunlight that physicians are treating them with arc lamps.

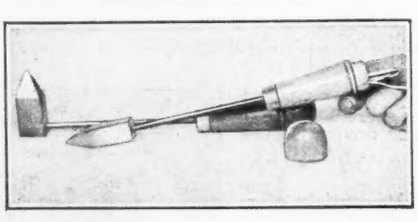
Barrels Joined Vertically in New Shotgun

A NEW firearm from Europe that is interesting American trap-shooters highly is an "over and under" type of double-barreled shotgun. It is a standard 12-inch-gage gun and has been used with great success by sportsmen for hunting and in target matches.

Trapshooter using the new gun, and view of barrel arrangement

It differs from the American single-barrel trap gun only in the number of its barrels. Its most obvious difference from the regular American double-barrel gun is the position of the cylinders, which are built one above the other instead of lying horizontally parallel.

Each barrel is 32-inch, full choke, and either can be shot separately. The gun weighs eight pounds and its pattern over a 30-inch circle is 70 per cent at a 40-yard range.



Handy New Soldering Iron

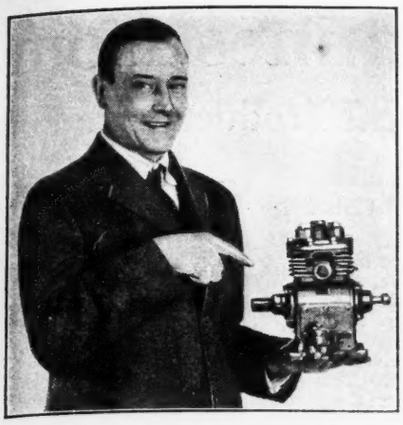
A NEW soldering iron has a hollow handle, in which self fluxing solder is kept. The iron is made in the conventional shape, and also with the head mounted at right angles for soldering a long seam easily.

Franklin and His Kite

OF TIMELY interest, in view of recent doubt cast upon Benjamin Franklin's kite experiment, is the recent discovery of a letter written by Franklin on the subject in a book published in London in 1774, now in the library of the Franklin Institute, Philadelphia.

After describing how to make the kite, with a pointed wire on the upright stick, Franklin says:

"As soon as any of the thunder clouds come over the kite, the pointed wire will draw the electric fire from them, and the kite, with all the twine, will be electrified, and the loose filaments of the twine will stand out every way, and be attracted by an approaching finger."



Tiny Air Compressor Runs at High Speed

THIS miniature air compressor is one of the smallest practical machines of its kind ever made. Its size and weight are such that it can be held easily in one hand. It is 9½ inches high, weighs 18 pounds, and has a piston displacement of three cubic feet.

It can make 2500 revolutions a minute, though the normal speed is 1250. One of the many uses for such a small compressor is on an automobile.

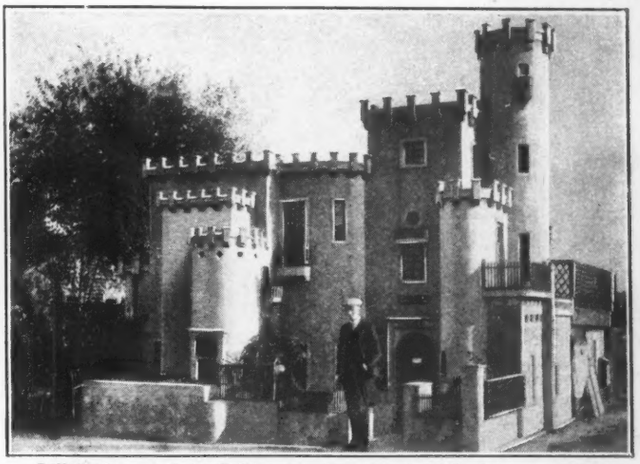
Miniature Castle Is Actual Home for Two

THE smallest livable castle in the world, located in Alhambra, Calif., is occupied by a man and his wife, both of normal size, who, one would think, must find it cramping at times.

Its proportions were just right for the band of circus Lilliputians who once lived in it, but how full-grown adults can live there is a mystery to those who have seen the elaborate little structure. A comparison with the man of normal size standing in the gateway shows the smallness of the doors and windows.

The rooms and the stairway to the second floor are proportionately miniature in size.

Guests rarely see the interior of this queer castle. There is no room for them.

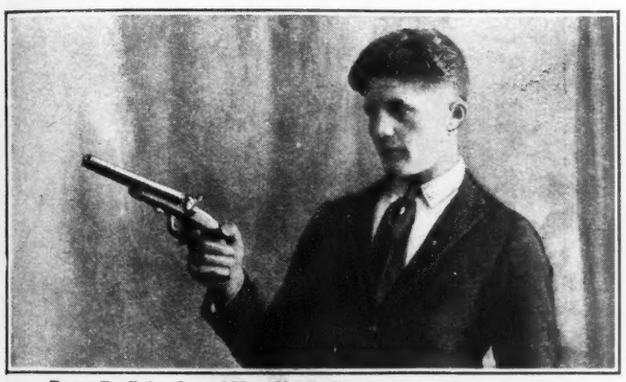


Lilliputian castle in California. Compare it with the man in size

A TON of mammoth tusks taken in Siberian glaciers, and said to be 50,000 years old, were sold recently in England to be made into billiard balls.

Smallest Shotgun Is Fired like a Pistol

A TWENTY-GAGE shotgun reduced to the minimum is owned by Patsy Ruffalo, Jr., of New York, who believes it to be the smallest and most perfect one ever made. Its length is 12½ inches over all and it is fired like a pistol.



Patsy Ruffalo, Jr., of New York, firing the smallest shotgun

One Eye

A ONE-EYED fish with apparently normal vision has been produced in the experimental laboratories of the University of Chicago, according to a recent announcement. In the experiment, the eyes of the fish were removed, and one was transplanted into the forehead.

This amazing operation was performed by Dr. Theodor Koppyani, famous European eye specialist, and J. Franklin Pearcy, research student in the university, searching for a cure for blindness.

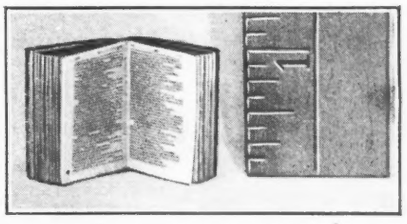
Breakage Takes the Profit from Egg Shipment

THE job of transporting eggs from the farm to the city and country stores so that you may have your supply for breakfast is one beset with extreme difficulties, because of the large amount of breakage. For this reason the railroads class the hauling of eggs as traffic without profit. New York City alone consumes 1,800,000,000 eggs a year.

The breakage of eggs in transit sometimes is due to the character of the shells, which may be too fragile to stand a long journey. Fertile eggs, too, are likely to be smashed on the trip. The annual loss from fertile eggs in the United States is estimated by the U. S. Department of Agriculture to be more than $15,000,000.

The railroads have been conducting experiments recently to improve methods of shipment.

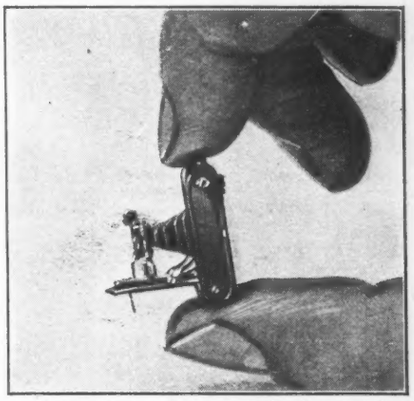
Dictionary an Inch Long



OWNERSHIP of the world's smallest dictionary is claimed by Peter Genkile of Cleveland, Ohio. The midget book, which came from Pompeii, Italy, is only one inch long, three-fourths of an inch wide, and quarter of an inch thick.

World's Smallest Camera for Queen's Doll's House

AN ASTONISHINGLY tiny camera, hardly bigger than a thumbnail, is complete to the smallest detail, including a crystal lens. It was presented recently to Queen Mary of England by the Kodak Company for her famous doll's house.



Hardly larger than a man's thumbnail

When closed, this camera, the smallest in the world, is 1/1728 the size of the camera of which it is a copy. It is only three-quarters of an inch high. Every part was made separately by hand, microscopes and jewelers' tools being used. The process of manufacture took three months in all.

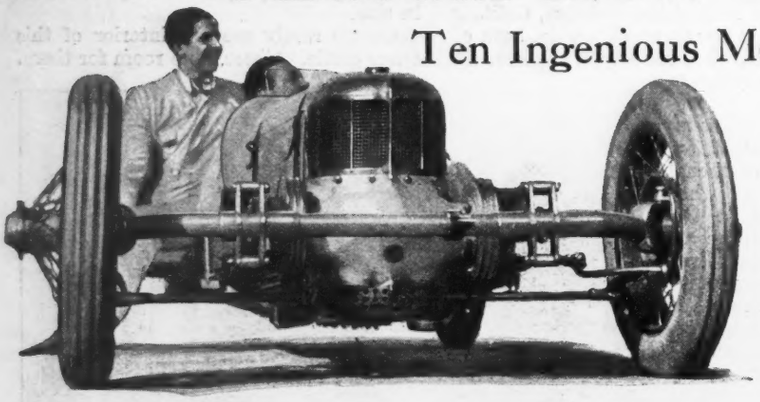
Most of the difficulty was given, not by the intricate metal parts, but by the bellows. These, after many experiments, finally were made of paper.

New Foe of Mosquito Pest

THAT the mosquito plague may be exterminated by raising a type of stingless mosquitoes guaranteed to expel the stinging variety was the recent statement of Dr. Louis Paul Le Gendre to the French Academy of Sciences. He said the stingless variety thrives in parts of Brittany.

Unusual New Machines from

Ten Ingenious Mechanical Products Are Put

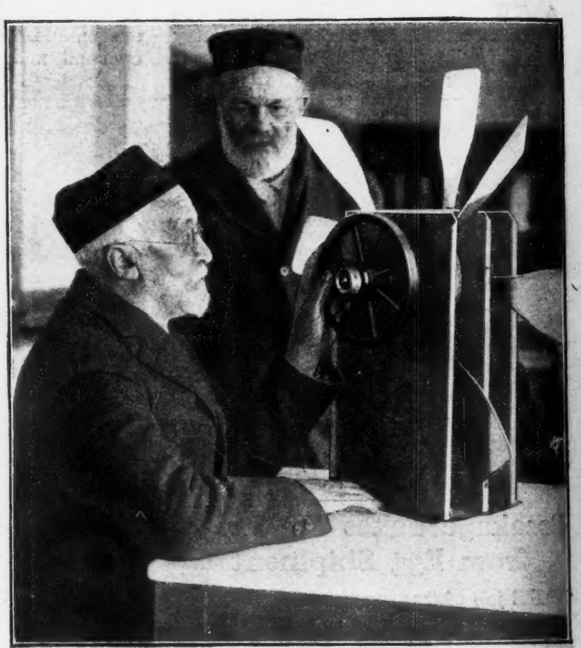


Front-Drive Racing Car—Cliff Durant, American millionaire sportsman and speed king, introduced this revolutionary type of motor-car during recent try-outs for races on the new speedway at Culver City, Calif. The engine is geared to the front axle instead of to the rear, thus pulling the car instead of pushing it

This Machine Counts Coins

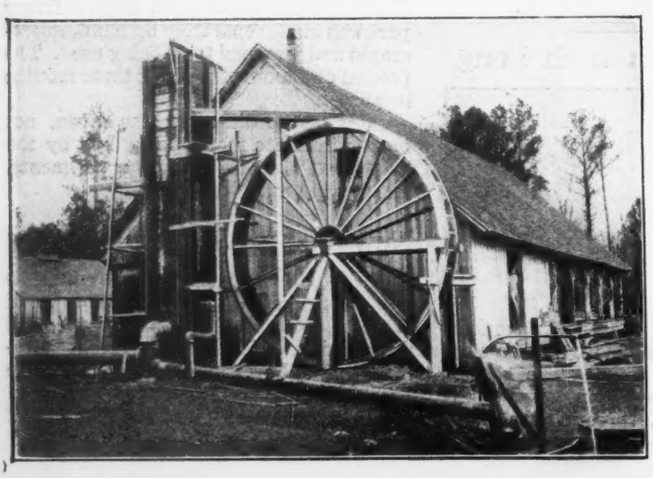
Coins of all sizes are pushed into a receptacle, from which they are picked up by a revolving disk device driven by electricity. This carries them along a rack that automatically sorts and distributes

Speed in Brickmaking—By a new system of multiple molds (shown at left and in man's hands), one man, it is said, can cast 4000 bricks a day, thus saving labor and cost



He Invents Wind Machine

After 30 years' work, Hyman Rosen, a blind inventor of New York City, has completed a wind machine that he hopes will do away with the need of coal and gas for fuel. The wind-driven vanes that supply the power are arranged to alter their positions as they revolve, thus presenting their edges when moving into the wind, and thereby reducing resistance



Well Drives Mill

Two artesian wells from which hundreds of gallons of water gush daily are utilized to run a Georgia sawmill. Natural pressure forces the overflow to a 30-foot water tower, from which it drops through a flume to turn a water wheel 29 feet in diameter

←

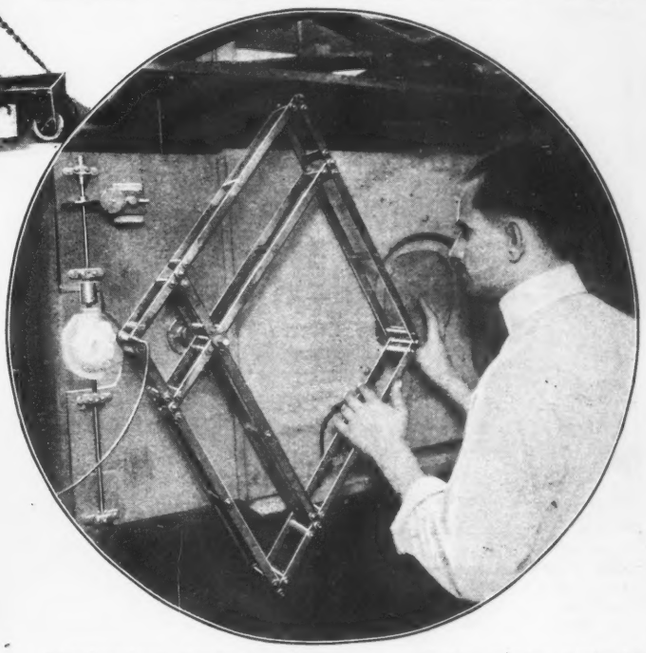
the Workshops of Inventors

to Work for Greater Every-Day Efficiency

Does Work of Ten Men

A new mechanical marker designed for the rapid painting of highway traffic lines, is said to be able to mark a 200-foot line, from three to eight inches wide, in one minute equal to the work of 10 men. The machine weighs only 160 pounds and is operated by one man

Mechanical Swimming Teacher—On the cushion of this curious machine, the swimming pupil lies with limbs strapped to the device. Turning a handle gives the correct movements



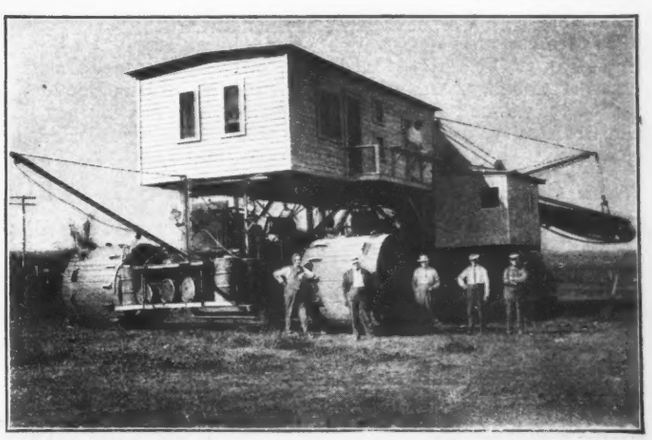
Mechanical Sculptor—By means of this newly devised pantograph, E. F. Engleman, an engineer of Hawthorne, Ill., creates complete, well sculptured heads from photographs

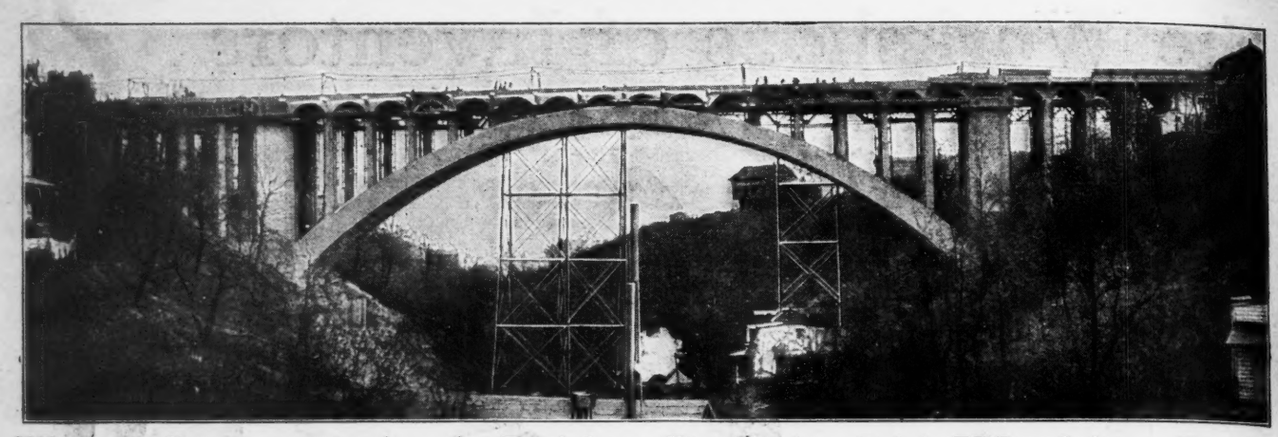
Saves Farm Labor

A plow that does the work of a breaking plow, pulverizer, harrow, and drag, is the recent invention of William Turner, of Chicago, Ill., who got his idea from wood-chopping machines in paper mills. Two rosettes of steel blades pulverize a strip of ground 14 inches wide, slice the soil and chop weeds and rubbish into fine pieces

Huge Ditch-Digger

Digging 1300 feet of ditch 12 feet wide and four feet deep in eight hours is an ordinary day's work for a mammoth new 90-ton excavator driven by a 120-horsepower gasoline motor, which recently has proved itself a practical invention on a reclamation project at Albert Lea, Minn. →





Huge Concrete Arch Bridge Built in 244 Working Days

THE second largest solid concrete arch bridge in the world—the Jack's Run Bridge at Pittsburgh, Pa.—was completed recently in 244 working days. It is 325 feet long and 170 feet high, and in size is second only to the Cathleen Memorial Bridge at Minneapolis, Minn.

Engineers designed the huge arch so that it will compensate for any expansion in bridge span by rising.

This bridge is located on the Lincoln Highway leading out of Pittsburgh to the north. It stands as a monument to modern engineering skill, for within considerably less than a year after the first excavations for its foundations were made, motor vehicles were passing across its wide span.

Engineers Design a Miniature Niagara Falls

Two views of the miniature Niagara, constructed to show how the falls may be further harnessed

TO DEMONSTRATE to Secretary of Commerce Herbert Hoover and other members of the Northeastern Super-Power Committee that the famous cataract of Niagara may be further controlled for power purposes without marring its beauty, a miniature of Niagara Falls recently was constructed in exact detail, on a scale of 100 to 1, by engineers of the Niagara Falls Power Company.

Because of the present demands of industry on the water supply, there is fear that the falls soon will be an object of scenic beauty only on Sundays and holidays.

The model was constructed to show Secretary Hoover and his committee how this contingency may be avoided by the building of islands and other means.

Electricity Milks Cows on French Farms

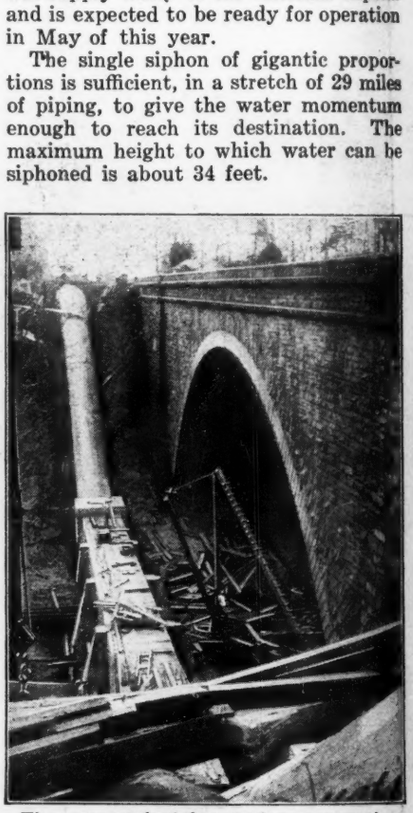
TO SAVE French agriculture, which is suffering acutely from a shortage of labor, officials of the government are cooperating with leaders of industry and agriculture to extend the use of cheap electric power in the rural districts. The State is assisting this development by grants and loans to cooperative societies formed to provide local low-voltage electric-supply mains.

An evidence of the increased use of electricity in villages is the fact that there are now 302,000 electric lamps, as compared with 65,000 in 1919. Electrically operated machines now do the chores on the farm. They milk the cows, skim the milk, and churn the butter. In almost every line of farm work, electricity is doing the work more cheaply than before and in a fraction of the time.

The World's Largest Siphon Built in Washington

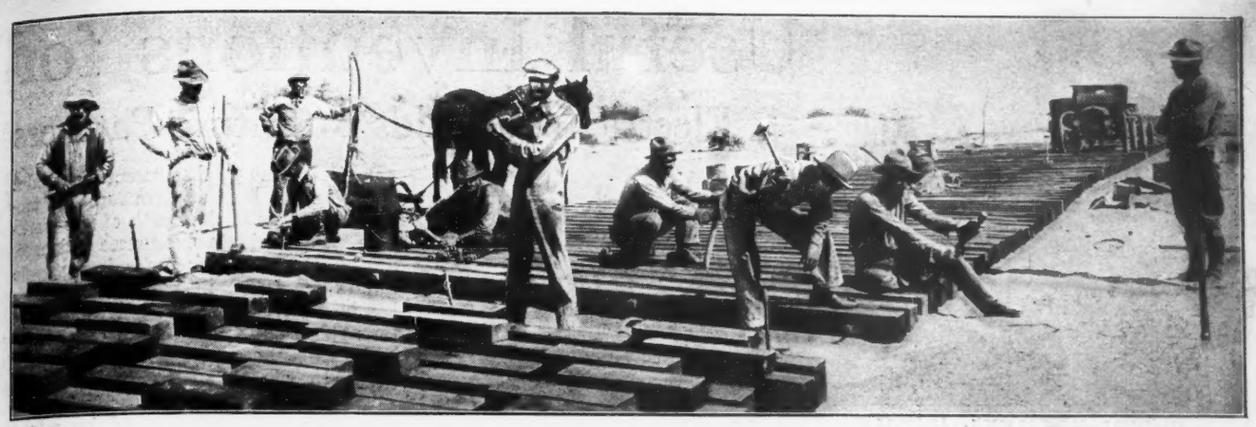
AN AUTOMOBILE could be driven through the world's largest siphon, which is nearing completion on the outskirts of Washington, D. C. It is to be used for the Great Fall conduit, which will supply water to the national capital and is expected to be ready for operation in May of this year.

The single siphon of gigantic proportions is sufficient, in a stretch of 29 miles of piping, to give the water momentum enough to reach its destination. The maximum height to which water can be siphoned is about 34 feet.



The mammoth siphon under construction

WHAT do you want to know? The Information Department of POPULAR SCIENCE MONTHLY will be glad to answer your questions on subjects of general science.



Portable Highway Defies California Sandstorms

WORSE than snowdrifts for blocking roadways are the great clouds of sand that whirl over the famed sandhills of Imperial County in southern California. Always after such a storm, tons of sand must be removed, or a new roadway laid.

Engineers are meeting the difficulty with a portable highway, 18 feet wide, made of redwood timbers bolted together. After a severe sandstorm a truck equipped with a crane lifts up a section of the roadway, shakes it clear of sand, and replaces it.

Aviator Shoots Photographs from a Parachute

NEWS photographers are accustomed to working in dangerous places, but G. A. Shoemaker, of the Army Air Service, is said to be the only one who risks his life regularly by falling in order to take pictures.

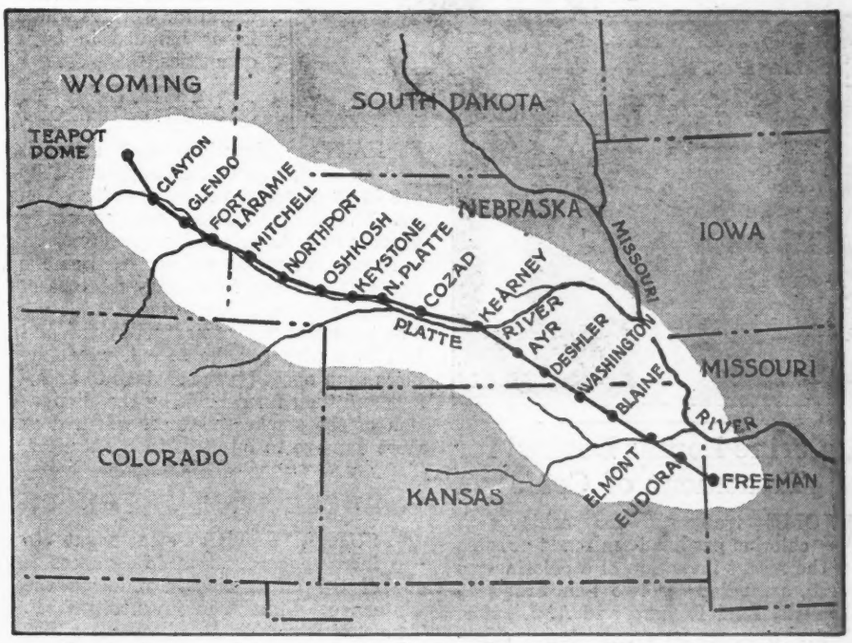
With three small motion-picture cameras strapped to his belt, and a parachute on his back, this daring photographer, a senior instructor in parachute jumping, leaps from the wing of a Martin bomber.

As he falls, he looks about him calmly, taking photographs of bits of scenery or other objects of interest. If the parachute opens properly and he lands safely, he then has for sale several photographs that are of unusual value and interest.

Ready to jump from the wing

SAFETY methods have cut accidents to eyes 90 per cent in some industries, according to a recent survey by the Eyesight Conservation Council of America.

New Pipe Line to Tap Wyoming Oil Fields



Map showing route of the 740-mile pipe line from Teapot Dome, Wyo., to Freeman, Mo., where it will connect with another line running from Houston, Tex., to Chicago, Ill.

THE network of pipe lines for the transportation of crude oil—that vast system that covers the eastern part of the United States—is slowly reaching its tentacles westward. Within a year, crude oil from the oil fields of Wyoming will be flowing to Eastern refineries through steel pipes laid underground.

There is now under construction a line 740 miles long, which starts in the famous Teapot Dome region of Wyoming, extends across eastern Wyoming, diagonally across Nebraska and Kansas, and ends at Freeman, Mo., where it connects with another pipe line that runs from Houston, Tex., to Chicago, Ill. Through this line, crude oil at the rate of 40,000 barrels a day will flow to refineries at Chicago, Kansas City, or Houston.

At the western end the line begins at an elevation of 5000 feet. Within the first 20 miles it climbs to 6100 feet, and from there on it drops steadily to an elevation of 800 feet at Freeman. The drop is almost exactly one mile.

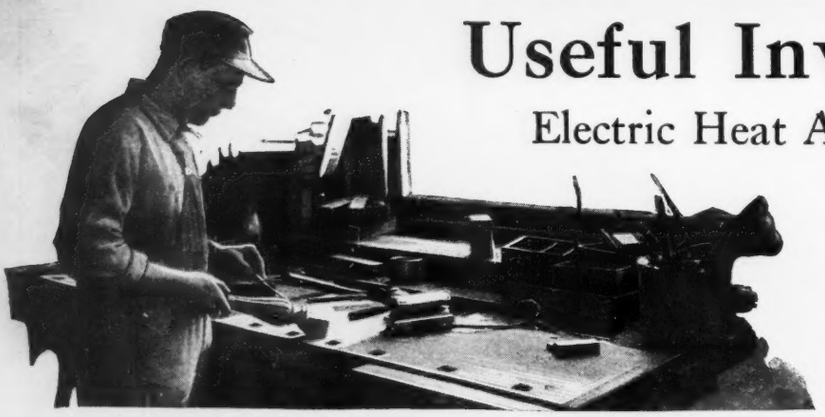
Owing to the slow-flowing quality of the oil, pumping stations are required at intervals of approximately 40 miles.

Cannon Fired by the Sun Tells the Time

THE only known automatic sun gun in the world, located at Cintra, 20 miles from Lisbon, Portugal, booms the correct time to surrounding towns and hamlets from a height of 2000 feet.

By a convex lens arrangement supported by the cannon, and controlled by a sun-dial, the sun's rays are concentrated at noon each day on the touchhole of the cannon, and thus it is automatically fired by old King Sol himself.

Useful Inventions for



Furniture patcher at work. In front of him is the small cylindrical knife-heater

Electric Heat Aids Furniture Patchers

OPEN flame torches recently caused a fire in a large eastern furniture factory, resulting in the death of two workmen. To eliminate this source of danger, a new electric furnace for heating the knives employed in patching furniture has been invented. The knives are used for applying stick shellac to cover holes and blemishes, and must be heated to spread the shellac.

The small furnace is in the form of an aluminum cylinder mounted by means of two aluminum castings on a finished asbestos base. Each end of the cylinder is open for the insertion of the knives. The furnace is lined with a rust-resisting metal called "monel."

The photograph shows a furniture patcher at work. In front of him may be seen the electric furnace with knife inserted.

Ice Mittens Made of Pronged Metal Plates

ICE mittens for conveniently lifting and carrying a cake of ice to the refrigerator have been devised by Valentine Dexheimer, of Montrose, N. Y.

Each mitten is made of two metal plates hinged together. Small upstanding prongs are punched in the plates to grip the ice. Canvas or leather straps attached to the plates fasten around the hands. The mittens are particularly useful for workers where ice is handled in large quantities.

Pair of ice mittens and how they are used

Stoves Doomed?

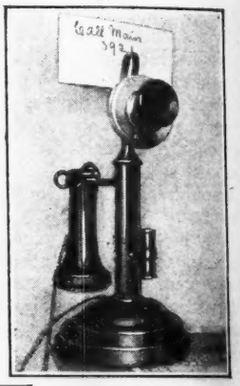
THAT the American coal stove is doomed, and will be supplanted by gas heaters was the recent prediction of W. W. Steere, Detroit engineer, in a report to the American Chemical Society.

Losses in American cities from smoke and soft coal run into many millions of dollars annually, Mr. Steere asserted. The increased cost of heating houses and buildings with gas, he added, would be more than offset by the savings to buildings and their furnishings by the elimination of the smoke nuisance, which does more damage to interiors than exteriors.

Phone Clip Holds Messages in Plain Sight

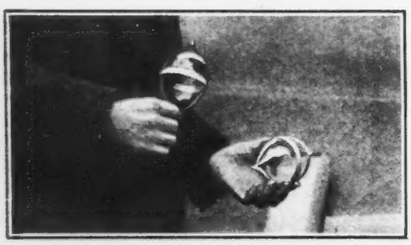
TELEPHONE messages frequently go astray. Written on a scrap of paper, they often fall to the floor and are lost.

This metal clip snaps on the telephone as shown, and holds the message securely.



Chlorine Bombs Devised for Treatment of Colds

HOME treatment for colds with chlorine gas has been made possible by the recent invention of a chlorine-gas bomb, perfected by two San Francisco chemists, Paul Richard and A. J. Price. Central agencies for administering chlorine gas are found in only a few large cities, and this device is designed to make the new cold treatment available to every one.



Breaking the bombs releases the gas

The bomb is made of glass and contains pure filtered chlorine gas. The user breaks off the ends of a bomb in a closed room, not more than 12 feet square, and remains in the gas-filled room for one hour, after which time, it is said, unless the cold is deep-seated, the patient feels relief.

Superheater Invented to Save Furnace Fuel

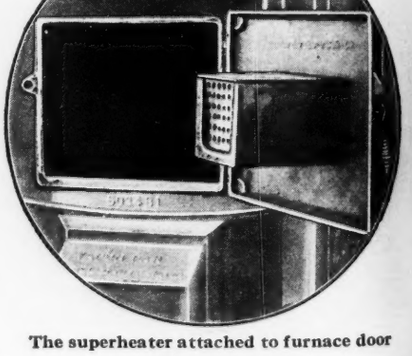
A SUPERHEATER attachment to increase combustion in furnaces is one of the latest aids in reducing the winter coal bill. The inventor, A. F. Tardie, of Riverside, R. I., estimates that with his new device 30 per cent more heat can be obtained from a pound of coal.

Much of the fuel waste in hand-fired furnaces is due to the fact that gases rising from burning fuel fail to ignite because of lack of air, and escape unused up the chimney. Air flowing through the grate is exhausted when it has passed through a few inches of the fuel bed.

The new box-shaped superheater ignites the gas above the burning coal, by admitting oxygen at a very high temperature over the fuel bed. It is fastened on the inside of the firebox door of the furnace.

The box is divided into three compartments, separated by perforated plates. Air drawn in by the draft enters through a slide in the firebox door. As it passes through the compartments its progress is retarded by baffle plates, thus causing its temperature to increase in each succeeding chamber. It finally passes out in fine streams through a perforated plate, at a high temperature, into the combustion chamber, or fire box, of the furnace.

Ashes from furnaces equipped with this device are said to be very fine, and practically no wastage of coal passes through the grates.



The superheater attached to furnace door

WHAT do you want to know? The Information Department of POPULAR SCIENCE MONTHLY will be glad to answer the questions of readers on subjects of general science.

Home, Shop, and Office

Automatic Card Index Is Time-Saver

INSTEAD of keeping many separate files for classifying subjects alphabetically, by localities, by industries and other headings, a new automatic time-saving card system permits all information to be kept in a single file.

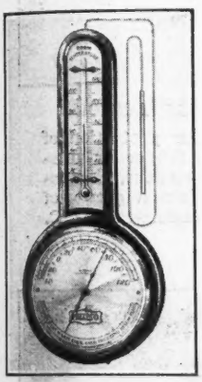
Pushing a rod into a numbered slot in the front of the cabinet automatically lifts all of the cards of a desired classification above the rest in the file. Each container holds 600 cards.

Pushing a rod into a numbered slot at the front selects the desired cards

Thermometer Tells Outdoor and Indoor Temperatures

A NEWLY invented thermometer that can be hung on the wall of the living-room or in the office registers both indoor and outdoor temperatures.

Attached to it is 15 feet of tubing with a sensitive bulb on the end. The tubing is run outdoors through a hole in the window-frame, and the bulb is inserted in a bracket outside of the building.



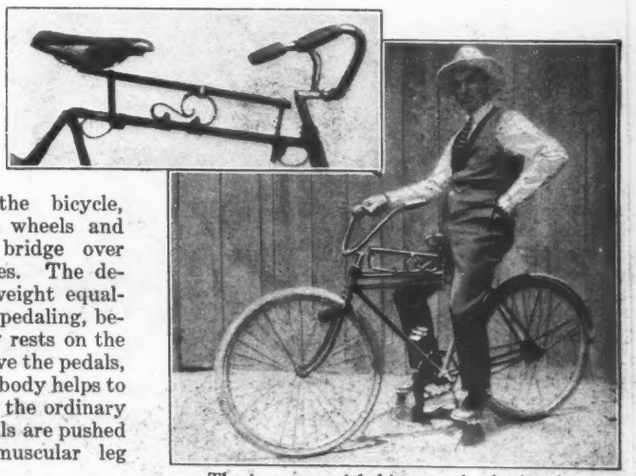
The top of the thermometer is similar to ordinary household thermometers, while the outdoor temperature is indicated on a round dial with a pointer. The use of this thermometer saves many a bad cold due to sudden, unrealized change in temperature.

Invents a Shockproof Seat for Bicycles

JOLTS and bumps suffered by the rider of an ordinary bicycle injure the spine, declares E. M. Faure of Los Angeles, Calif., who has invented a shock-absorbing seat that can be clamped easily to any bicycle.

The springs of the new shock absorber are so arranged that the weight of the rider rests upon the center of the top horizontal bars of the bicycle, thus causing the two wheels and frame to act as a bridge over the road's irregularities. The device also acts as a weight equalizer, permitting easier pedaling, because the rider's body rests on the seat more directly above the pedals, and the weight of the body helps to push them down. In the ordinary arrangement, the pedals are pushed almost entirely by muscular leg movement. The height of the seat can be adjusted.

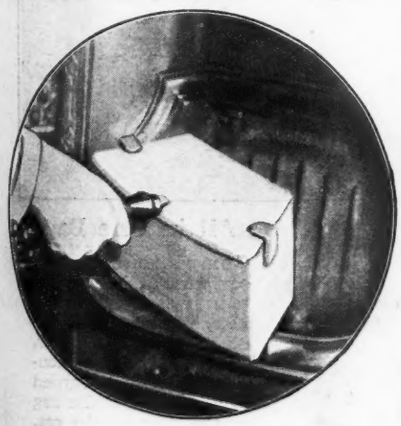
The seat can be attached to motorcycles as well as to bicycles.



The inventor with his new shock absorber

Rooms Heated Quickly by New Portable Fire

A PORTABLE fire is a recent invention for warming a room quickly when one does not wish to light a coal fire. With it a dining-room can be warmed economically for mealtime only, or a cold guest-room prepared for an unexpected visitor.



The heater fits into an open range

The device consists of an aluminum box so shaped as to fit into the ordinary open range. It has a lid with handle. The box contains absorbent wool, which, after the lid is removed, is soaked with a pint of paraffin.

When lighted, this will give a hot fire for one hour, which is sufficient to warm the average room. When the fire is no longer desired, it is extinguished by putting the lid on the box, and the whole thing then can be carried to another room.

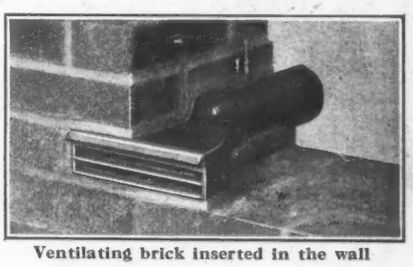
A New Artificial Wood

A REMARKABLE new material known as "plastic wood" recently has been perfected for such uses as repairing furniture, filling cracks in wood, restoring picture-frames and broken corners and filling nail holes or countersunk screws.

This artificial wood can be worked and finished with carpenter's tools, like any lumber. It comes in the form of a thick paste that can be molded to any shape. When exposed to the air it hardens into a tough, waterproof material. This characteristic makes it especially valuable for restoring missing parts of any article of furniture.

Ventilating Brick Draws Fumes from Kitchen

A VENTILATING brick inserted in the kitchen wall near the ceiling, as the mason is bricking in, is said to remove all gas fumes, steam and cooking odors from the room, and prevent the walls from becoming discolored. It can be used also in pantries, bathrooms, washrooms, hung ceilings or closets where air becomes stale or is circulated with difficulty.

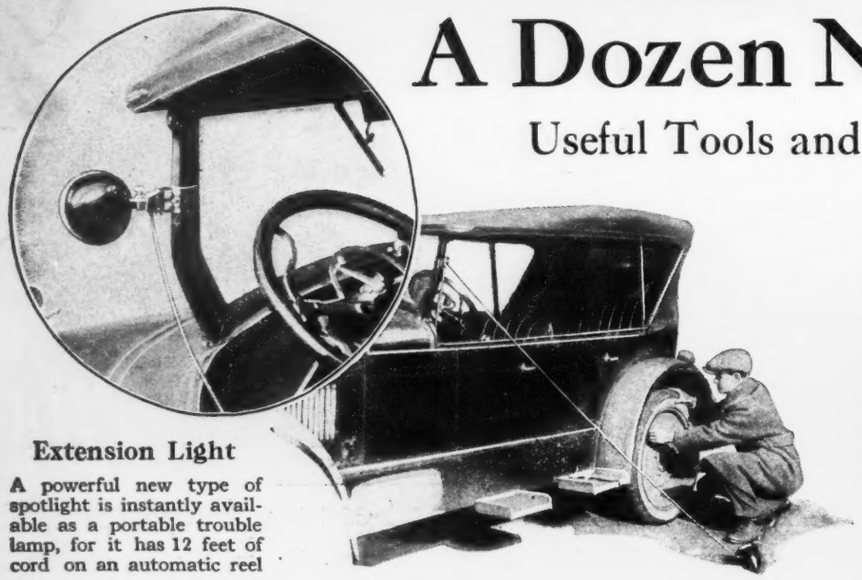


Ventilating brick inserted in the wall

The special advantage of the device is that it takes up no more space than the standard 13-inch brick. The brick is made of cast iron or bronze with a heavy galvanized iron flue.

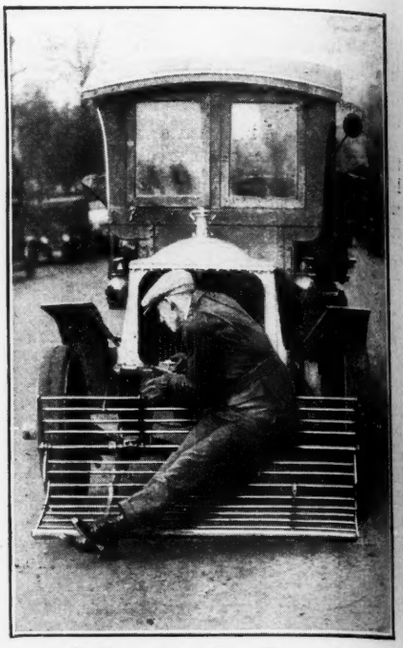
A Dozen New Ideas

Useful Tools and Accessories Invented



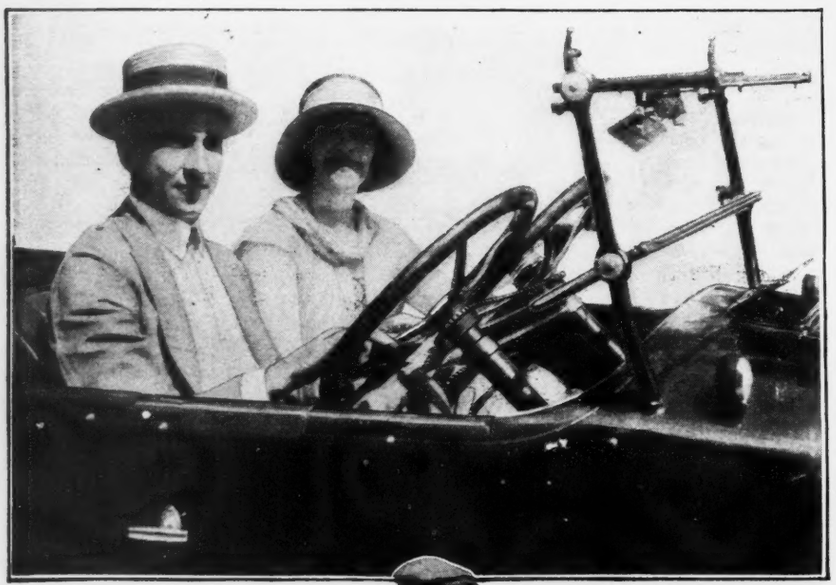
Extension Light

A powerful new type of spotlight is instantly available as a portable trouble lamp, for it has 12 feet of cord on an automatic reel



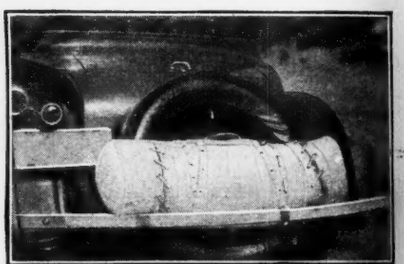
Safety Fender Tested

The latest device for protection of pedestrians is a cage fender for automobiles and motor-trucks, demonstrated recently before a group of traffic experts in Washington, D. C.



Twin Steering Wheels

Jack Neal, an auto dealer of San Antonio, Tex., invented this double-steering-wheel method of teaching how to drive

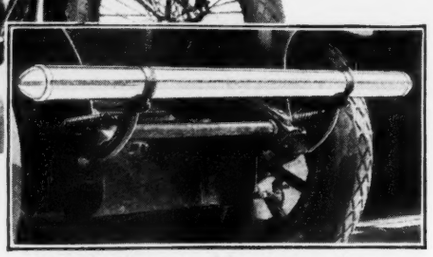


All in One Bag

Complete camping equipment, including tent, two woolen blankets, rubber sheets, bedding roll, two stoves, cooking and table utensils, all can be carried in a compact duffle bag at the rear of the car, as shown in the upper picture. In addition, it will hold enough food for two persons for three ordinary sized meals

A Windshield for the Sidecar

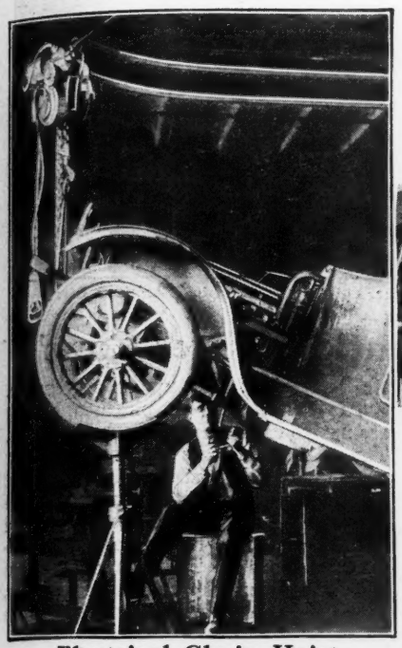
Comfort for the passenger of a motorcycle sidecar is provided by a new streamlined windshield that can be attached in half a minute. The frame of the shield can be adjusted to any angle the rider desires



Absorbs bumps—Mounted on heavy coiled steel springs, this new bumper is designed to take up all road shocks

for the Motor-Car

to Increase Safety, Comfort, Economy

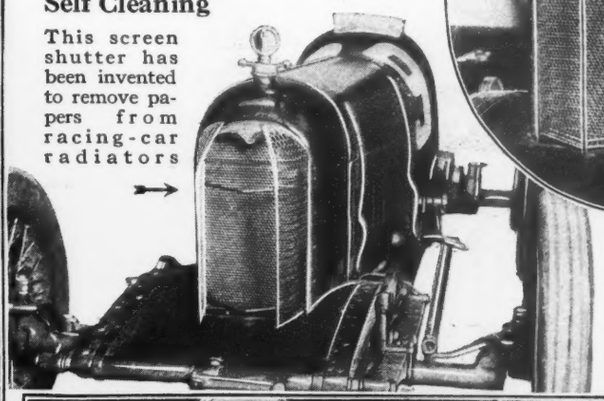


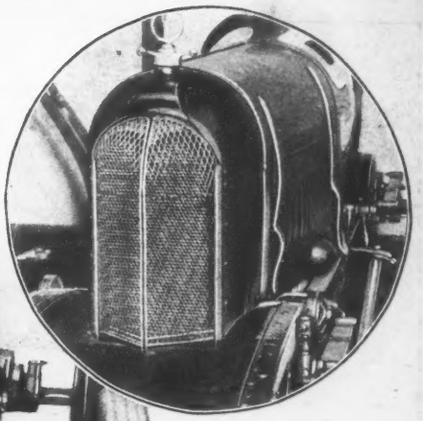
Electrical Chain Hoist

For lifting operations in auto-repair shops this electric chain hoist recently has been perfected. Power for the motor is obtained from any electric-light socket that happens to be near

Self Cleaning

This screen shutter has been invented to remove papers from racing-car radiators →

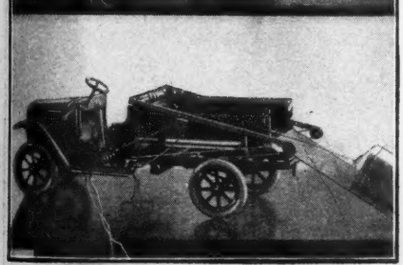




Removes Papers

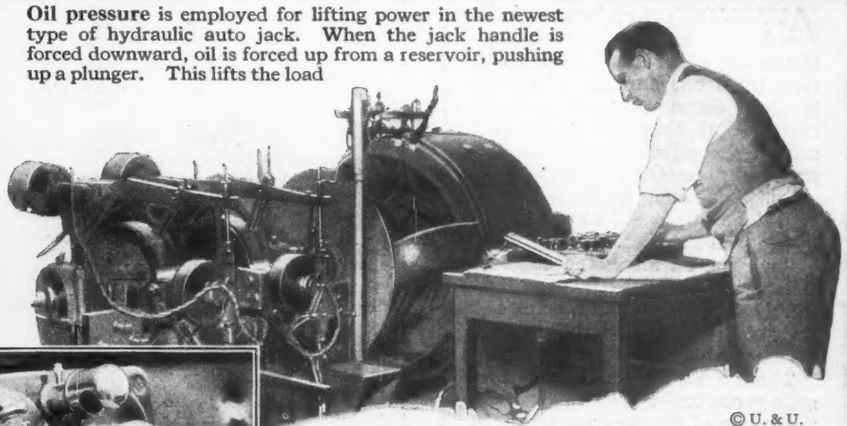
The screen covering the radiator (above) opens (left) when the driver pulls a lever, forcing the papers off

Oil pressure is employed for lifting power in the newest type of hydraulic auto jack. When the jack handle is forced downward, oil is forced up from a reservoir, pushing up a plunger. This lifts the load



Loads Itself

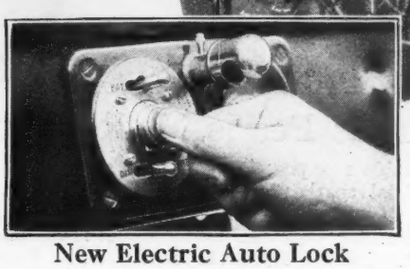
A motor-truck that will load and unload itself by its own power is the recent invention of Herbert C. Stone of Brooklyn, N. Y. It is equipped with a skid to move heavy materials on and off. By means of a specially adjusted automatic platform, it will handle successfully face brick in evenly stacked piles



© U. & U.

U. S. Tests Brake Linings

To assure motorists better service from their brakes, the U. S. Bureau of Standards recently began tests of various brake linings used in automobiles. Carl H. Roeder is shown with the brake-lining testing machine. While this machine does not attempt to duplicate actual running conditions, it gives a steady run from which comparisons of brake-lining wearability can be made



New Electric Auto Lock

An electric lock, recently invented, is operated simply by pressing a button that shuts off the ignition. A switch key turns on the ignition for starting

South American Indian harpooning a giant pirarucu in the Amazon River

A day's catch of "river cows," or pirarucus, the largest fresh-water fish in the world, found only in the Amazon River and its tributaries

Thrills in Hunting "River Cows"

THRILLS and dangers, sometimes more than are desired, go with catching the pirarucu, the largest fresh-water fish in the world. The sport is reserved for the Indians of South America, for only in the Amazon River and its long tributaries is this giant fish found.

The pirarucu, known commonly as the "river cow," is somewhat like a whale. When fully grown it weighs more than 200 pounds. From the moment it is harpooned it imperils the life of the fisherman. It runs and rushes toward the canoe, threatening to overturn it. Only constant attention and extreme agility on the part of the native keeps the boat right side up on the surface.

The boats used for pirarucu hunting are native craft, half canoe, half rowboat. The fisherman floats quietly in his boat until one of the mammoth fishes rises and begins playing on the surface of the water. Then he paddles stealthily toward the fish, and when he reaches a good position, harpoons it. The spear shaft breaks from the point when it strikes the fish, which is held by a cord attached to the point.

Then comes a struggle that lasts often several hours. The fish churns through the water, pulling the canoe after it. From shore to shore and many miles up and down the river the angered mammal thrashes, attempting by every means to escape its pursuer.

Finally it is exhausted and lies passive. The Indian pulls it alongside the canoe and kills it with his machete. The day's catch is then towed triumphantly home.

Know Your Car

AUTOMOBILE springs are built in the form of leaves placed one above the other so that they can slide upon one another, absorbing shocks. Some springs become so rusted that they are practically solid. The effect is as if the car frame were fastened directly to the axles. For riding comfort, springs should be lubricated at least once in every 5000 miles.

Squirting oil along the edges of the springs does little good. It merely acts as a dust collector and little of it seeps between the leaves where the oil is needed.

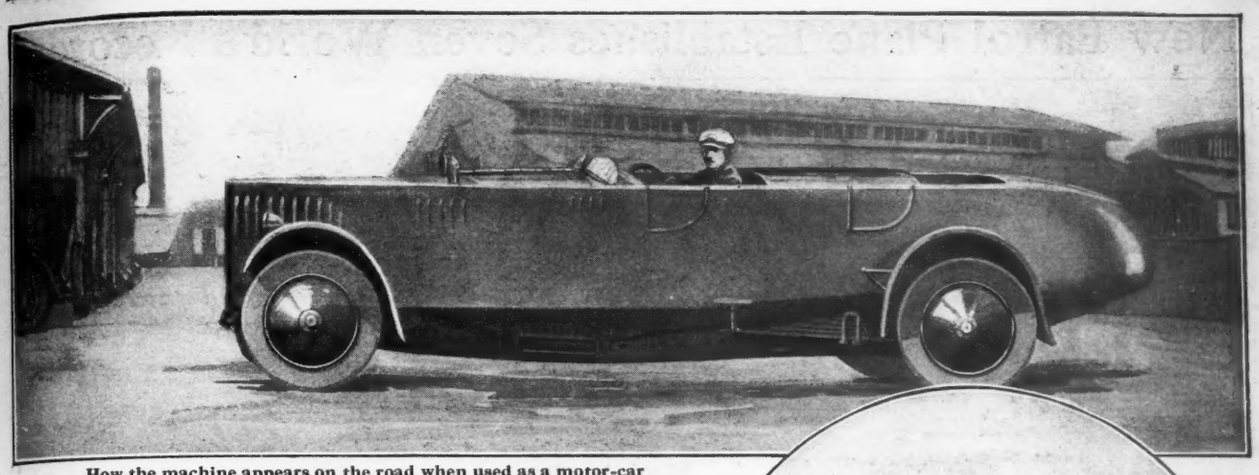
There is a short way to lubricate springs correctly. Put a jack under the frame of the car, not the axle, near the spring that you want to lubricate. Raise the frame until the wheel is free of the floor. When this is done it will be easy to separate the leaves with a screwdriver. Spread a little cup grease between the leaves with a putty knife, and the job is done. You will be surprised at the improvement in your car's riding qualities.

Lustrous Pearls Made from Fish Scales

BY A remarkable new process, pictured here, artificial pearls now are being manufactured from fish scales. These pearls have a luster that makes them almost indistinguishable from the real jewels.

Herring scales are placed in a bottle and a secret solution of chemicals is poured over them. These chemicals dissolve the scales and make them into a solution. This is placed in a pan and each bead is then dipped into the solution, after which it is set into a rack to dry.

The base of the pearl is made of a special smoked glass and is indestructible. Pearls of this type, which are dipped and handled by hand, sell at retail for about $200 a string.



How the machine appears on the road when used as a motor-car

New French Car also a Power Boat

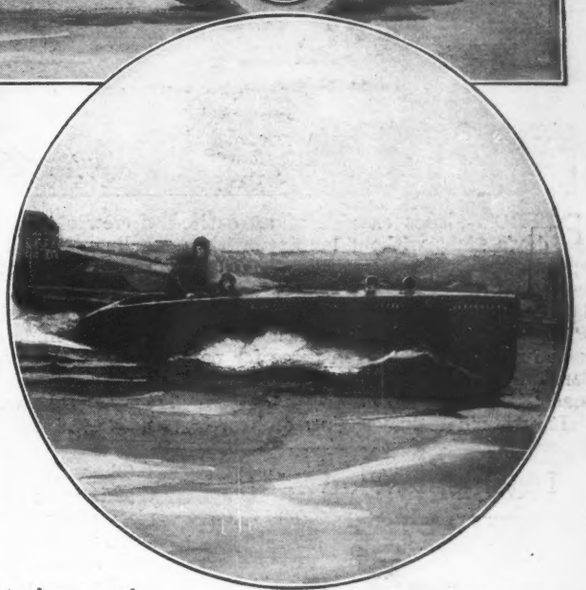
A COMBINATION automobile and motor-boat, invented recently in France, is of great interest to sportsmen and tourists. Unlike many types of craft designed for both land and water, nothing has been sacrificed in its construction. The complete mechanism of each has been retained. On land the car travels as fast as the average automobile, and in water it is a speedy power boat.

It consists of two parts—a chassis mounted on wheels and a shell. The shell is made of steel plates in imitation of those often used on ships, and has the shape of a canoe, with two passenger seats that can be raised or lowered. This body contains both sets of machinery and the controls necessary to run the boat and automobile.

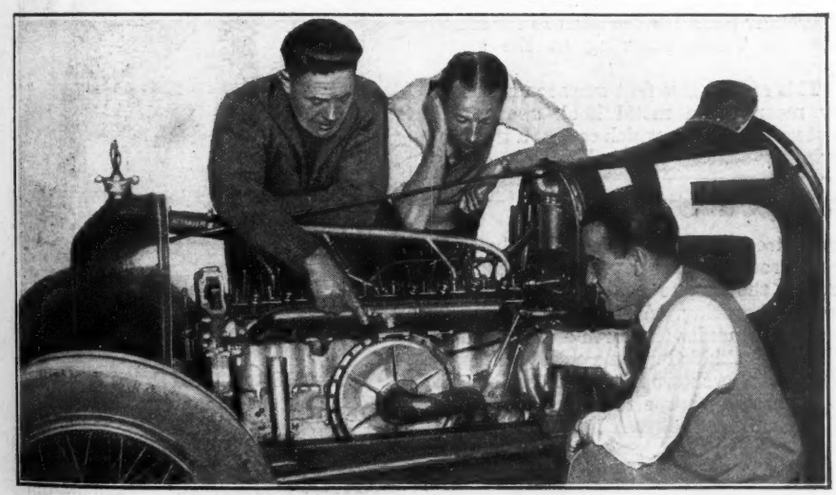
The motor is similar to those of ordinary automobiles and also those found on most small power boats. The engine is air-cooled and the steering-wheel serves both car and boat.

When an automobile is desired, the owner merely mounts the shell, by means of jacks, to the proper position on the chassis. To remove the shell, when the machine is to be used as a boat, is said to be even easier.

A NEW light-weight steam-power motor for airplanes and autos, invented recently by H. Crossland Pfaff, a New York mechanical engineer, soon may be tested by the government. The engine is said to burn crude oil, and the inventor claims it is capable of developing one horsepower a pound. If it proves equal to such performance, according to experts, it will be the greatest motor in the world.



The same machine transformed into a speedy power boat, driven by the same engine but with a canoe-shaped steel shell attached to the chassis



Speed Records Broken with Supercharger

IN THE Culver City Speedway classic at Los Angeles not long ago, the world's record for automobile racing was smashed by more than eight miles an hour. After the race, interested spectators gathered to examine the device largely responsible for the terrific speed of the cars—the supercharger.

Mounted at the side of the engine, the supercharger forces an extra charge of gas into the cylinders. It is the invention of Fred Duesenberg.

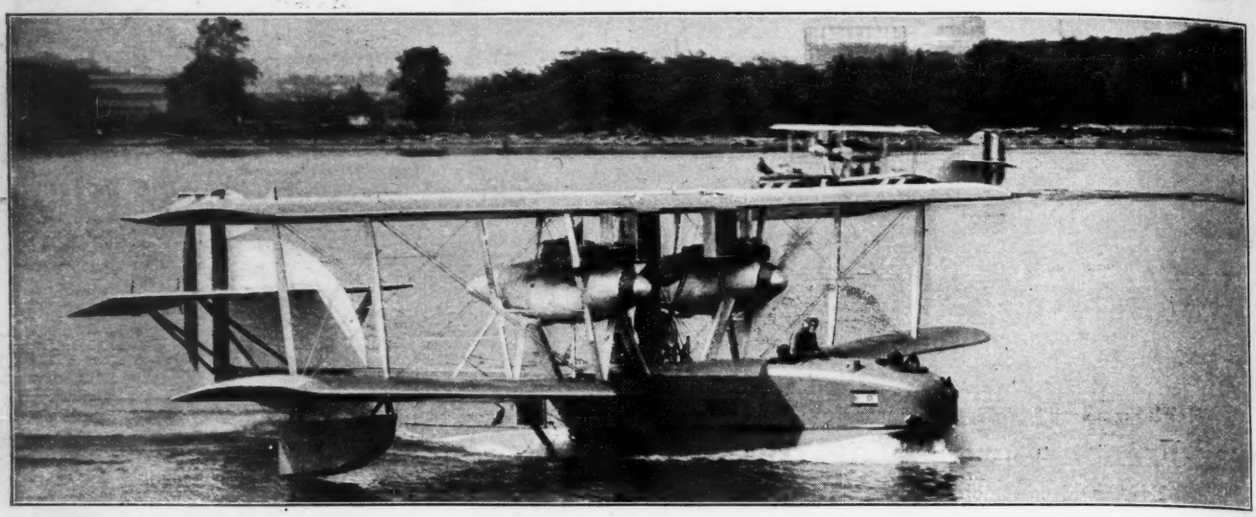
THE next radical development in the modern closed car, according to recent predictions, will be glass or celluloid sides and tops to give passengers an unobstructed view of the scenery.

How Much Science Do You Know?

ANSWER the following questions to the best of your ability, then turn to the correct answers on page 169 and see how nearly you were right.

1. What is the coldest thing in the world?
2. How much water is there in the sea?
3. Is the ether a real thing?
4. What things in the blood have the duty of destroying germs?
5. How strong does an electric current have to be before it will cause death?
6. Why does soap help to remove dirt?
7. How do we know that plant seeds are alive?
8. Are all the planets solid?
9. How do arteries differ from veins?
10. Are white people more like the yellow race or more like the negro race?
11. What rare metal is used on the tips of fountain pens?
12. How much real power is there in a radio wave?

New Patrol Plane Establishes Seven World's Records



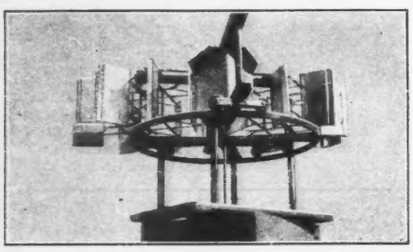
PATROL planes capable of an entire day's flight without landing, with a speed of more than 100 miles an hour, and with tremendous cargo space, are the latest type of naval flying boat. The PN-7 shown here has established seven world records and broken three for performance by seaplanes carrying heavy loads.

It has twin Wright engines and carries a crew of four men. Its tanks hold 489 gallons of fuel and the plane attains a maximum speed of 105 miles an hour. It has carried as great a weight as 16,500 pounds on a trip.

Great importance is attached to the value of this type of plane in possible sea warfare. With their wide cruising radius, they could meet surprise attacks from a long distance. They could hop off unsupported from San Diego, Calif., for Honolulu, thence to the Philippines. As coast cruisers they have constant usefulness.

Further developments in this sort of plane are being embodied by the Navy Department at Seattle, Wash., in a new plane. This will be capable of making 2500 miles in non-stop flight and carry a full load weight of 24,000 pounds.

Ingenious Wind Motor



A WIND motor generator producing an unusually large amount of power is the invention of L. Suter of West New York, N. J. It consists of two separate windmills with vertical planes that are set on opposite sides of a large hoop.

The entire motor turns on a track so that it faces the wind. A wedge-shaped piece of wood between the two windmills splits the air into two parts, thus making each current turn a windmill. Gearings at the top of the device transmit the power generated by the two mills to the main driving shaft.

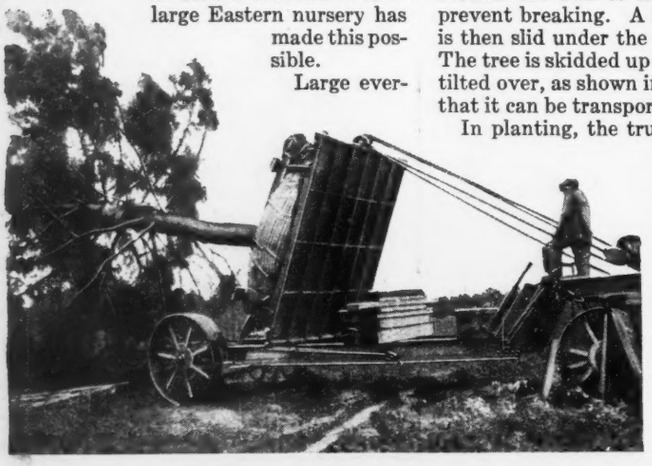
Plane Hooks Up to Airship

SPEEDING at 53 miles an hour above Scott Field, Ill., recently, a Sperry messenger plane hooked itself to the army dirigible TC-3, traveling at the same speed.

This remarkable feat was accomplished by means of a metal hook above the motor of the plane which caught a trapeze swinging beneath the airship.

Tall Trees Are Transplanted Successfully

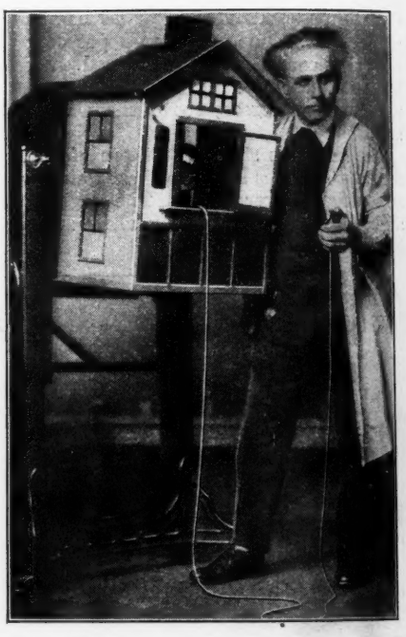
CONTRARY to tradition, full-grown trees may be replanted successfully. A recent invention of a large Eastern nursery has made this possible.



Large evergreen trees must be dug with a ball of earth around the roots. A lacing is placed around the ball to hold it securely and prevent breaking. A large steel platform is then slid under the earth and fastened. The tree is skidded up on a steel truck and tilted over, as shown in the illustration, so that it can be transported through streets.

In planting, the truck is hauled to the edge of the hole, the tree tilted upright, and skidded into the hole. After the tree is in the hole, the platform is pulled out from under the earth ball.

Deciduous trees are dug with bare roots, or with a small ball of earth in the center and roots extending.

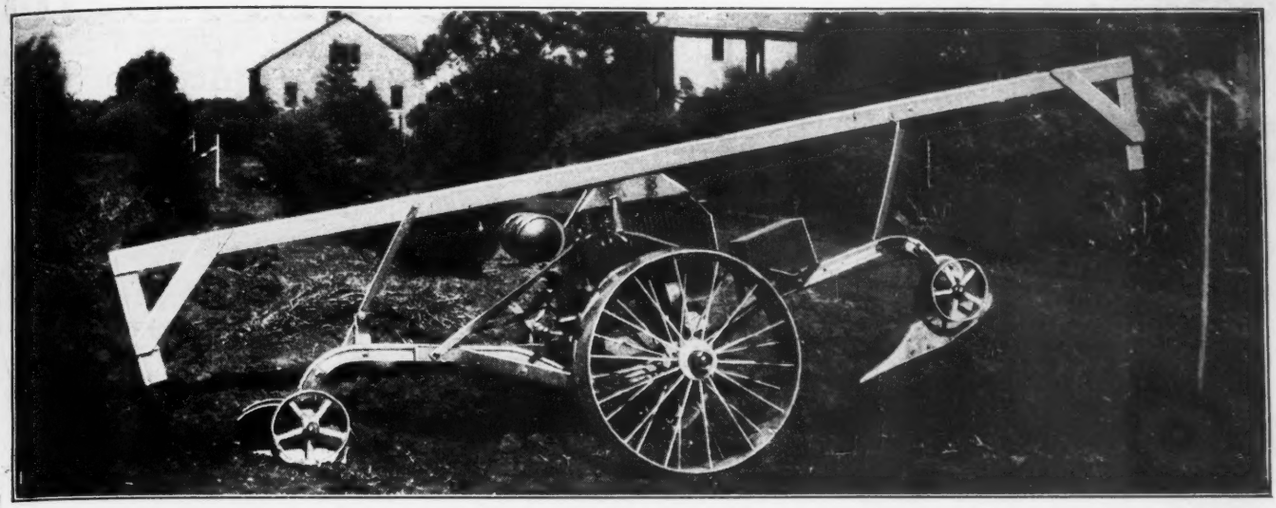


Toy Hides Camera Lens and Insures Child's Interest

BETTER than a rabbit or jumping monkey is this toy house, which a Cincinnati photographer, J. Anthony Bill, places over his camera lens while photographing small children. The child watches the little front door of the house. At any moment something may come out of it. The photograph records an expression of interest and expectancy.

Lenses that reflect light glaring forth from folds of black cloth are terrifying to many small children. This new device covers the lens and makes picture-taking a less painful process.

College Professor Invents an Automatic Gasoline Plow



FARM implements run by machinery were curiosities only a few years ago. Now inventors are going further and seeking to perfect farm machines that will run by themselves. One development is along the line of radio control of machinery, as described elsewhere in this issue; another has to do with the invention of purely mechanical automats that will turn corners as carefully as if guided by human hands.

In the photograph is seen an automatic plow driven by gasoline, invented by Prof. J. B. Davidson, head of the Agricultural Engineering Department of Iowa State University. All the farmer need do, it is said, is to wind up the mechanism and plow one furrow by hand, as a mark to govern adjacent furrows. The machine then will do the rest.

The inventor believes this machine will reduce greatly the yearly cost of plowing in the United States, now estimated at $150,000,000.

Folding Clock Devised by California Inventor

MARCEL MOREAU, inventor of a furnace that makes synthetic jewels from powders, has a hobby for making clocks in his spare time. One of the most curious of these is the folding clock shown in the photograph. It is two feet in diameter when opened, and folds into the small box the inventor is holding. The clock weighs only one pound and is so finely balanced that the large hands are run by the mechanism of a dollar watch placed in the center.

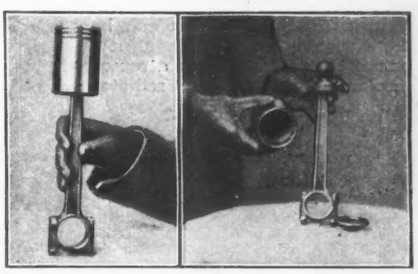
The odd timepiece is stem wound and set. When the inventor travels, he carries it with him instead of an alarm-clock.

Unique Machine Threshes Melons for Seed

THRESHING muskmelons and cantaloupes has been developed into one of the most important industries in southwestern Kansas—that of supplying melon seeds to large seed firms throughout the United States.

For this the melon-growers have devised a unique thresher, driven by a small gasoline engine, and mounted on a horse-drawn truck. The gathered melons are thrown into the hopper of the machine, where knives slice them as they fall into a conveyor that carries them into a revolving mesh reel. This separates the pulp and rinds from the seeds. The rinds, dropped from the machine, are used later as a winter feed for livestock.

In further processes the seed is cleaned and dried for shipping to various sections of the country.



New Ball-and-Socket Joint

A BALL-AND-SOCKET universal joint by which the piston rod of a gas engine is connected with the piston head was recently invented by John B. Humpert, of San Francisco. The head is said to adapt itself readily to any position, always in perfect alinement with the cylinder.

An important feature of the invention is that no crankpins are necessary.

Architects Send Sample Houses by Truck

CLEVER ideas in advertising have boosted the real-estate business recently in London. One enterprising firm there has built a model house, complete in every detail, on a truck that carries it to the door of the prospective customer.

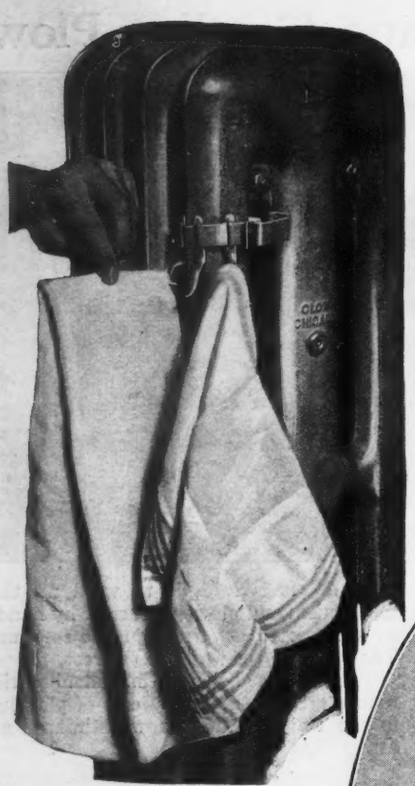
Another scheme is that of selling houses by mail. This is an idea of a London inventor, Mr. Partridge. You can choose clothing, food, and furniture from samples; why not houses? asked Mr. Partridge, who recently applied his idea.

He makes small model houses, complete in every detail, for architects, who send them to prospective clients. The prices are attached, and if the prospect is suited, he orders his plans.

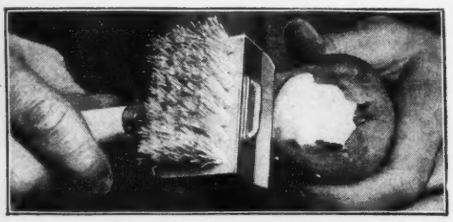
Exhibiting a model house, mounted on a motor-truck, to prospective buyers

New Utensils to

Inventions Designed to Save



A clothes-drying rack can be improvised quickly with a new metal clamp that holds a set of hooks tightly to the radiator



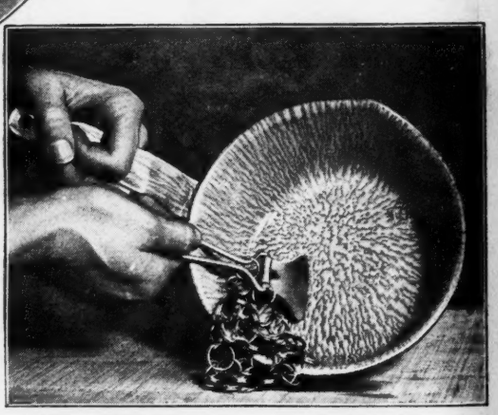
Scraper and scrubber for vegetables are combined in this handy utensil with blade on one side and brush on the other

Improved Can-Opener. This tool differs from the ordinary can-opener in that the cutting blade points inward. Pulling up the handle of the opener cuts the tin

Propeller Egg-Beater. Two eight-bladed propellers, rotating in opposite directions, produce a churning motion that beats the eggs very quickly. The propellers are attached at the bottom of a shaft that is geared to the drive wheel

Lifting the cap of a milk bottle is simplified by this metal lid with spiral knife. After the lid is pressed down, a twist and a pull remove the cap readily

Scrubbing-brush, mop, and wringer are combined in this useful new device for cleaning. The mop is held in wooden rollers. Brush or mop may be removed



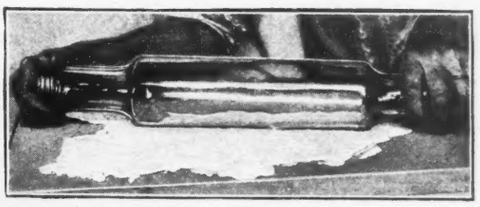
A pot-scraper with steel mesh attached is one of the newest devices for cleaning dirty pots and pans. The sharp scraper is particularly useful for removing food that has burned to the pan

Fuel economy is claimed for a new type of rapid gas-cooker with double burners. A smooth metal disk set above a corrugated disk over the gas outlet produces a strong double circle of flame

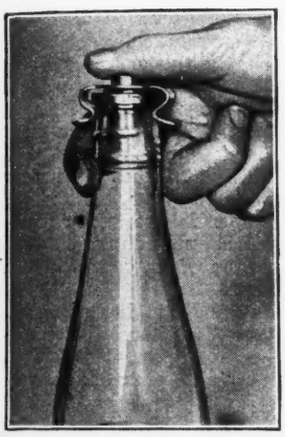
Help the Housewife

Time and Labor in the Home

An adjustable grip arrangement removes the top from any size of jar. The handles form bottle and can openers, as necessity requires



A new glass rolling-pin has one end open so that it may be filled with ice-water for pastry making

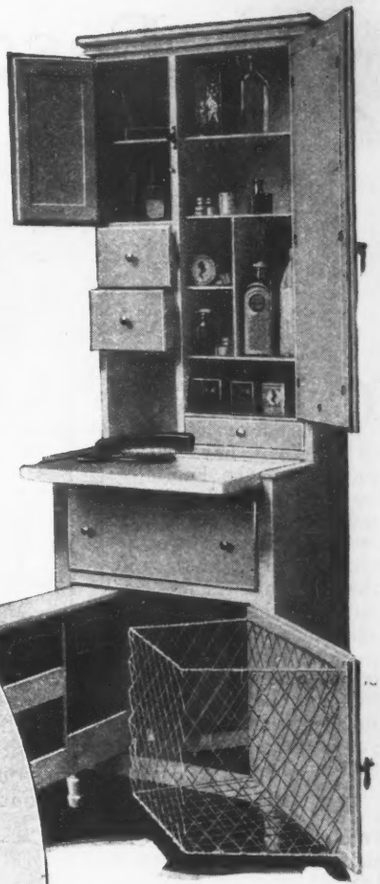


A new bottle stopper is automatic in action. When pressed down, spring clamps hold it tightly. The stopper is removed by slight pressure

Fireproof — One of the newest inventions for the electric iron is a steel fireproof case into which the iron can be placed after use. The case keeps it clean and dry and out of harm's way

No stirring of cooking food is required, it is claimed, when this plate is placed between the pot and gas flame, because the plate contains a double air chamber which distributes the heat evenly, making it impossible for more heat to accumulate at the center of the pot than around the sides. Waste of fuel and the danger of boiling over thus are prevented

Cooking without water is said to be possible with a new type of aluminum triple-bottomed pot. A tight-fitting top prevents the escape of moisture given off by the cooking food



For the bathroom, the newest convenience combines a compact cabinet and table, containing shelves for medicines and toilet articles, a series of drawers, a waste basket for soiled towels, and a sliding cabinet for shoes and slippers. The entire cabinet occupies only 22 by 17 inches of valuable bathroom floor space

A Fascinating New Way to Plan a Home

Architect's Ingenious Cut-Out Method Is like a Game

By G. Gouverneur Ashwell

ONE of the dominating American emotions is love of home. Most of us have mental pictures of the homes we hope one day to build. We may be a little vague as to detail, such as the exact size of the living-room or the location of the fireplace, but nevertheless the average American has a rather well defined idea of the kind of house he wants most.

You probably have made rough sketches of the home you want to own—sketches that outline in general your ideal house, but which, due to your lack of experience in architectural design, fail to show the very detail that is to make your home different.

Here, then, for the first time, is your chance to design your ideal home to the last detail so far as proportions, locations of doors, windows, pillars, stairs, kitchen, furniture, fireplaces, bathroom fixtures, and the like are concerned. The architectural details have been worked out for you according to scale on pages 86 and 87. You can devote your time to arranging them in the most artistic and practical manner.

All you will need in addition to diagrammatic units representing the walls, windows, and other items shown in this article are a large sheet of one-fourth-inch cross-hatched plotting paper, a pair of scissors and a paste-pot. The cross-hatched paper can be purchased at most stationery stores, or you can make it yourself. It should be about 22 inches by 30 inches to give you plenty of room to work. The squares should be one-fourth inch.

IF YOU want to make the cross-hatching yourself, simply rule off 55 parallel lines one-fourth inch apart one way and 85 lines at right angles to them on a blank piece of paper of 22 by 30 inches dimension. This paper will be your workbench. Mounted on some stiff base, such as wallboard or other heavy cardboard, it will serve as the plot on which you will build your dream house.

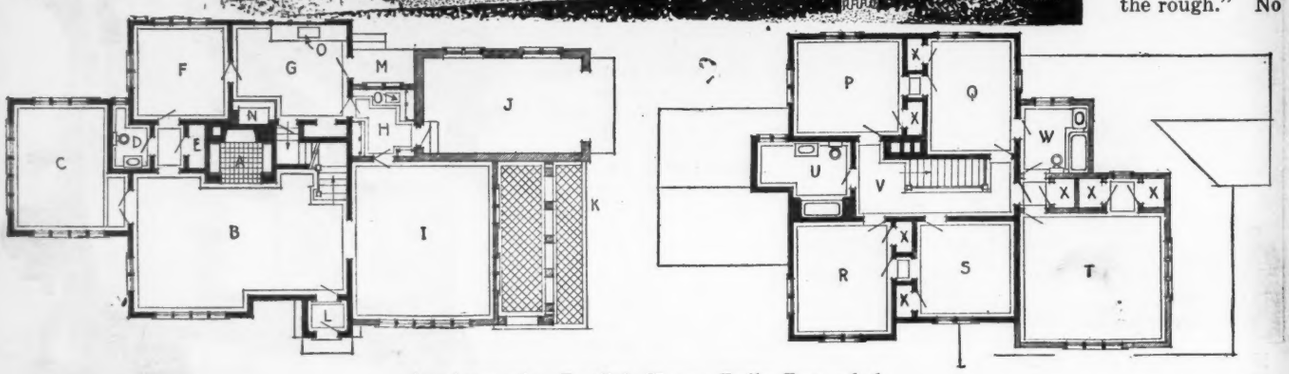
Now you are ready to lay out your house. Remember, though, that your designs will not be finished drawings from which a house can be built. They will be what an architect calls "preliminary sketches," that show your ideas "in the rough." No

Your Dream Home on Paper

HERE Mr. Ashwell, a well known New York architect, outlines an ingeniously simple way to put on paper dream homes such as most of us have tucked away in the back of our heads. For the first time the layman is offered a practical, workable way to plan his home in detail and to accurate scale.

Read the article carefully. Next, study the plans shown on this page and on page 85. Then put your scissors and paste to work on the cut-outs shown on pages 86 and 87.

If you wish, you may send tracings of your plans to The Editor, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. Accompany them with a stamped self-addressed envelope, and they will be returned with architectural criticisms and comments. Then you will be ready to consult your own architect, without whose advice you should not begin construction.



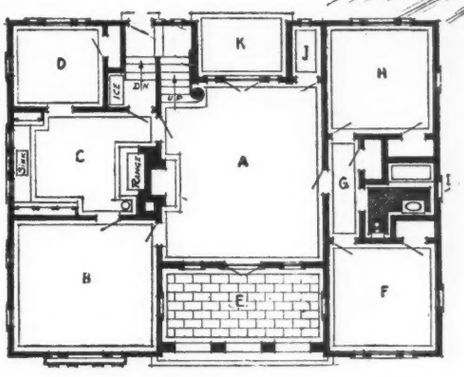
An Attractive English House Fully Expanded

What do you like best about this English dwelling? Study the floor plans carefully for ideas. This dream house has been expanded from the small house plans indicated by the heavy black lines in the floor plans shown in the illustration above. The first-floor plan (left) contains: *A*—Inglenook, 4'0" by 8'0", with fireplace and seats each side. *B*—Living-room, 16'0" by 27'0". *C*—Living-porch, 12'0" by 16'0". *D*—Toilet, 4'6" by 5'6". *E*—Coat closet, 2'0" by 5'6". *F*—Present dining-room, 12'0" by 12'0" (future den). *G*—Kitchen, 12'0" by 14'6". *H*—Future butler's pantry, 8'0" by 8'6". *I*—Future dining-room, 18'0" by 20'0". *J*—Future garage, 12'0" by 20'0". *K*—Future covered porch, 11'0" by 20'0". *L*—Vestibule, 4'0" by 5'6". *M*—Rear porch 4'6" by 8'0". *N*—Range. *O*—Sink. The second-floor plan includes: *P*—Bedroom, 12'0" by 13'6". *Q*—Bedroom, 11'0" by 14'0". *R*—Bedroom, 12'0" by 14'0". *S*—Bedroom 12'0" by 12'0". *T*—Future bedroom, 16'0" by 18'0". *U*—Bathroom 7'0" by 9'0" and 4'6" by 5'6". *V*—Stair hall, 7'0" by 19'0". *W*—Future bathroom, 8'0" by 8'6". *X*—Closets, 2'0" by 4'0" or 2'6" by 3'6"

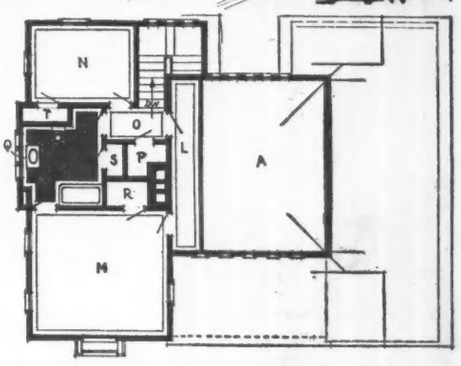
A Spanish House Full of Interesting Ideas

If you study the arrangement of this Spanish type house you will find many interesting features that you may wish to incorporate in your own plans. This house, too, is capable of expansion as future needs require. The plans for the first floor include: *A*—Living-room (two stories high), 18'0" by 20'0". *B*—Bedroom or future dining-room, 14'6" by 16'0". *C*—Kitchen, 11'6" by 14'0". *D*—Dining alcove, 9'0" by 10'0" (future den or sewing-room). *E*—Loggia or porch, 8'0" by 18'0". *F*—Future bedroom, 12'0" by 12'0". *G*—Future hall, 3'6" by 11'0". *H*—Future bedroom, 12'0" by 12'0". *I*—Future bathroom, 6'0" by 7'6". *J*—Future coat closet, 3'6" by 6'0". *K*—Terrace or porch, 7'0" by 10'0". Closets, 2'0" by 4'6".

The second-floor plan contains: *A*—Upper part of living-room. *L*—Balcony, 3'6" by 20'0". *M*—Bedroom, 14'6" by 16'0". *N*—Bedroom, 9'0" by 12'0". *O*—Stair hall, 3'6" by 7'0". *P*—Linen closet, 4'0" by 4'6". *Q*—Bathroom, 9'0" by 9'0". *R*—Closet, 3'0" by 4'6". *S*—Closet, 2'0" by 4'0". *T*—Closet, 1'6" by 5'6"



Plan of first floor



Plan of second floor

building operations should be undertaken until a competent architect works out the detail drawings and specifications. But these preliminary sketches should give your architect an adequate understanding of your ideas and should save you a great deal in construction charges.

FIRST of all, study the sketches and floor plans shown on these pages. They will give you an idea of how to lay out your house. These plans represent three of the most popular types of architecture—English, Spanish, and Colonial. They are flexible, being capable of expansion without much alteration when more room is needed. The accompanying sketches of the finished houses show them as they will appear when all additions are made.

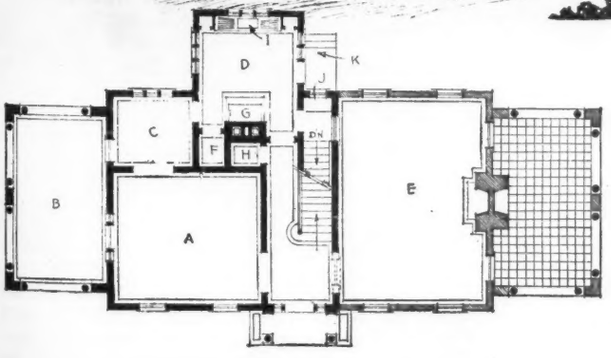
In the floor plans the original house is shown in black lines, and the additions in light lines. Any one of these houses can be designed originally to accommodate comfortably a family of two or three, and later extended as the family grows or as finances permit a larger house. You may want to model your house after one of these plans, changing it, of course, to suit your particular needs. But the plans are shown primarily to guide you in laying out your own plans, no matter what they should happen to be. You may have altogether different ideas of a home.

Now, make a number of rough sketches of your home, until you get definitely in mind your general floor plan. Then make a more finished freehand sketch that will serve you as a model. Next, cut out the long black strips shown on page 86. These represent walls and partitions, and may be cut to any length desired, each quarter-inch representing a foot in your walls.

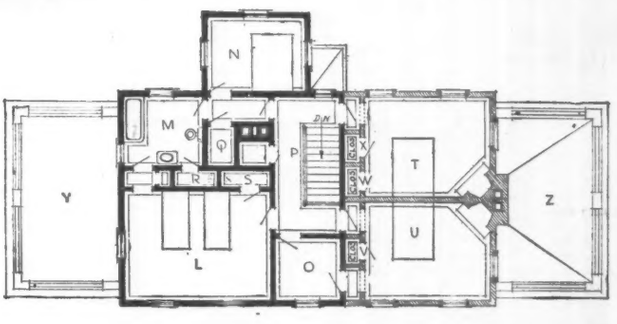
With four pieces of the walls form one

This Colonial Plan Suggests Many Conveniences

In a roomy Colonial house such as this one, you will find many advantages and conveniences that you can adapt readily in laying out the plans for your ideal home. The arrangement, too, adapts itself readily to future expansion. *A*—The present living-room, 16'0" by 18'0", can be converted into the future dining-room. *B*—Living-porch, 12'0" by 20'0", becomes a future garage. *C*—Dining alcove, future butler's pantry. *D*—Kitchen, 12'0" by 12'0". *E*—future living-room, 18'0" by 25'0". *F*—Pantry. *G*—Range. *H*—Closet. *I*—Sink. *J*—Icebox. *K*—Rear porch. *L*—Bedroom, 13'6" by 18'0". *M*—Bathroom, 8'0" by 12'0". *N*—Bedroom, 9'0" by 12'0". *O*—Future bathroom, 8'0" by 8'0". *P*—Linen closet. *Q*—Closet. *R*—Closet. *S*—Closet. *T*—Future bedroom, 12'0" by 15'6". *U*—Future bedroom, 12'0" by 15'6". *V*—Closet. *W*—Closet. *X*—Closet. *Y*—Roof. *Z*—Roof.

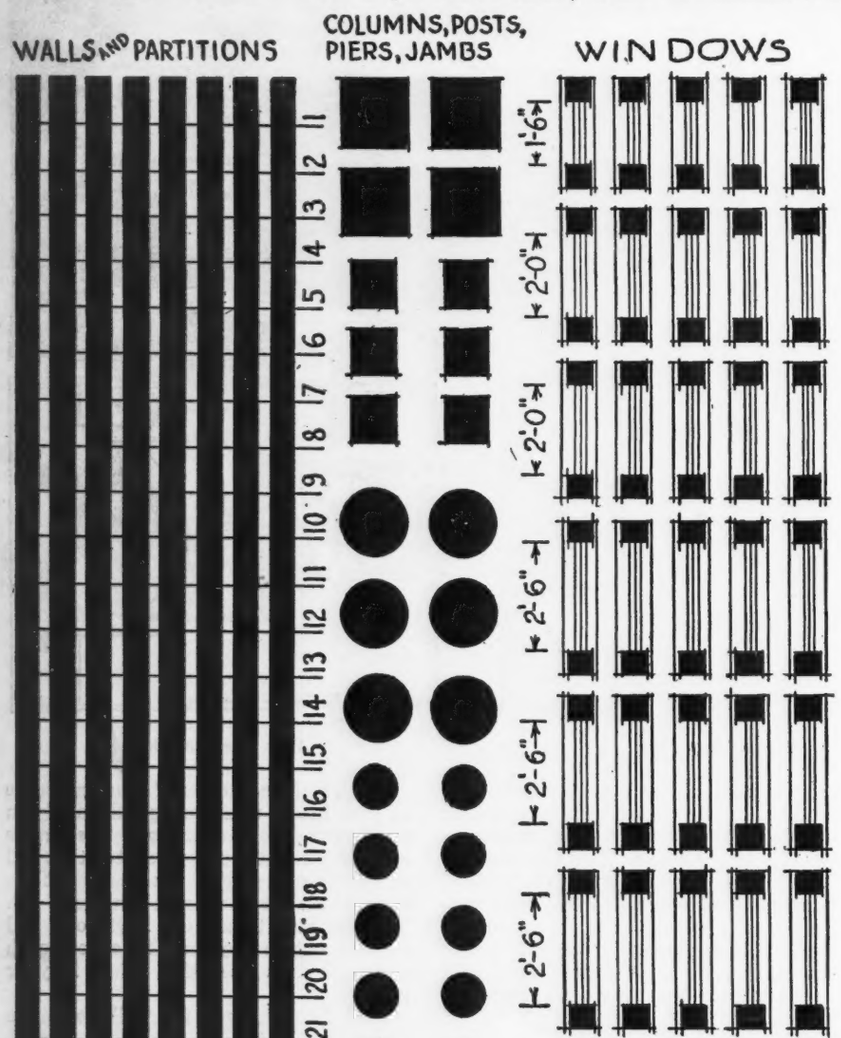


Plan of first floor



Plan of second floor

Here Are Your Walls, Columns, and Windows



How to Use the Cut-Outs

After you have studied the designs of the three popular types of homes on the preceding pages and have formulated in your mind a fairly definite idea of your ideal home, you are ready to lay out your floor plans on a definite scale of measurement, using the cut-outs on this and the opposite page. The thick, black lines are your walls and partitions, which you can cut to any required lengths, remembering that each quarter of an inch represents a foot of your walls. The columns, posts, piers, jambs, windows—in fact, all the cut-outs on these pages—represent standard sizes measured accurately to the same scale—one-quarter of an inch representing one foot in the finished house. To "build" your rooms, you arrange these cut-outs on quarter-inch cross-hatched plotting paper. In this you will be guided by the fact that each square of your paper represents a square foot of your house and that each side of a square is a lineal foot room of your plan by pinning them to the plotting sheet. Determine dimensions from the squares on the plotting sheet (one side of any of these squares represents a foot, and the square itself a square foot). Then, in like manner, lay out the other rooms, shifting about walls and partitions until you think you have what you want. With the walls temporarily pinned to the plotting sheet, the next step is to locate windows and doors.

Doors are indicated by leaving an opening in your wall or partition. Closet doors require a space of 2 feet 6 inches; room doors, 2 feet 8 inches, or 2 feet 10 inches; exterior doors, 2 feet 10 inches, or 3 feet, or 3 feet 6 inches; double casement doors from 4 feet to 5 feet.

ON THIS page you find a selection of windows of various sizes. Cut out the sizes desired for each room and pin them on the wall strips where desired, with some thought as to how they will look on the outside wall, and as to how furniture will be placed with relation to them. Don't paste anything yet.

Now for the final details of design. Starting with the living-room, pick out a fireplace of the right size from the illustrations on page 87. You may have one or more fireplaces in your house, if you desire. Try to keep the kitchen range near a fireplace so that only one chimney will be required for both. Now place the heater flue so it comes in the same chimney. Bear in mind that flues and fireplaces must have eight inches of brick on all sides or between flues and fireplaces.

When you have your fireplace in position, check up and see that it is located to allow the correct wall space for bookcases and other built-in features, and also that it is in the proper location with relation to windows and doors. If you consider the room well balanced, you may leave it as it is; but if the fireplace seems to be out of position, you can move your windows, doors, or the hearth itself to get the arrangement you want.

After you have laid out the rooms on the first floor, arrange your furniture in them as a final test of their correctness of design according to your needs. You can do this by drawing small squares, circles, and various shaped rectangles on a scale one quarter inch to a foot to represent your piano, davenport, upholstered chairs, etc. If you find your windows are too close together to allow placing the davenport between them, for example, or that your doors interfere with the placing of other pieces of furniture, it is an easy matter to pull out the pins and rearrange a detail here and there. In the kitchen place your sink, range, icebox, cupboards, and other necessary furniture, using the cut-outs on page 87. You then will be able to decide just where you want your light plugs and where you want your doors.

THIS matter of providing correct space for furniture and fixtures is an extremely important one, especially if you plan to use your present furniture in the ideal home you are planning. Measure each piece of furniture carefully, and after you have prepared a paper unit cut to scale, try placing it in various parts of the room to see where it will be most convenient and where it will present the

best appearance. Many a new home, otherwise attractive, has been spoiled simply because the furniture would not fit into it properly.

After you have completed the first floor of the house, lay out the second floor on a piece of tracing paper, to conform with the design of the ground-floor plan. Remember that houses need closets. In laying out your upper floor, your architectural ingenuity will be taxed to get enough closets and at the same time keep them from taking up too much room space. They may be set to good advantage between two rooms, each room taking part of the space. Also the space under stairways may be utilized for storage closets.

IN LAYING out your bathroom be sure to place your window, if you have only one, to the best advantage. This should be placed so that the light will fall on you when you shave and at the same time light the rest of the room. The bathroom fixtures provided in the cut-outs can be arranged to suit the particular size and shape of your room. Tubs come in several sizes and shapes. Washbowls also offer a wide selection.

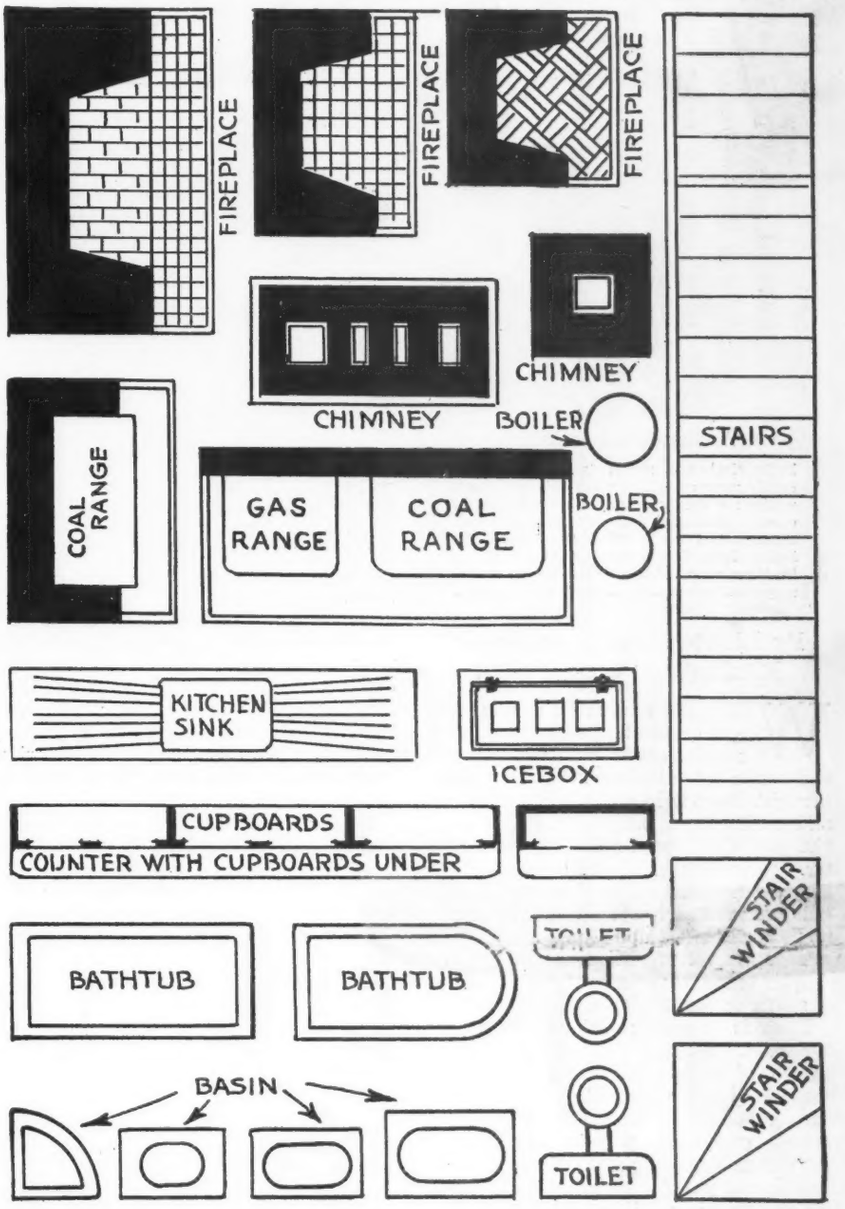
On another piece of tracing paper lay out your cellar. The stairs should come up under the stairway leading to the second floor. Put your furnace near the same chimney that is intended to serve your fireplace and kitchen range, unless you want two chimneys, and make allowance for the convenient location of the coalbin and ash receiver. And don't forget to provide for an entrance from the outside.

If you desire, a separate room can be marked off for storage of canned fruits, vegetables, and the like. If you intend to place your laundry tubs in the basement, put them as far away from the furnace as you can. A separate basement room is desirable for laundry work.

YOUR original house should have one bathroom, one living-room, and one bedroom at least; also space for stairway to second floor and stairway to cellar. Many houses appear to be awkwardly cut up because the stairways are not conveniently placed. In a Colonial house with a hallway, the placing of the stairway is a simple matter. There is no place but the hall for it. But in houses that have no hall the stair should be made to fit in as part of one of the rooms. The living-room usually is the place selected for the stair. Some attractive effects can be got by bringing the stairs down in artistic turns.

The stairs shown on this page represent a standard size. They have a seven-inch rise and a 10-inch tread, are fairly easy to ascend and are in general use. A six-inch rise and 12-inch tread make easy and attractive stairs. There are, however, other standard widths for stairs that you may use if you like, ranging from 2½ feet for cellar and attic steps to 4 feet for main stairways. If you use a platform where your stair turns at right angles, the platform takes the place of one tread. If you turn with winders (shown in the cut-outs), each group of winders takes the place of three treads. For the seven-inch step, 17 risers or 16 treads are required to reach from first to second floor.

Here Are Your Fixtures, Chimneys, and Stairs



No matter how you arrange them, the rises will be the same.

You can build the stairs to suit your design, cutting up the flight in sections and inserting winders or platforms where and as you choose.

When you have completed your design and have decided there will be no more changes, then paste all walls, windows, flues, and other stationary fixtures in place. You then will have a complete preliminary plan from which any architect could work out specifications and working drawings for the home of your dreams.

The entire process, from cutting out the units of the floor plans and arranging them in various schemes to measuring and fitting in your furniture to the best advantage, you will find as entertaining and fascinating as a parlor game. If you encounter difficult problems here and there, don't be discouraged. That is part of the game. And in the end you will have created something of real value to yourself.

How Well Can You Fit Them In?

Now comes the final test of your ingenuity. How accurately and skilfully can you cut and fit these fixtures—stairways, windows, cupboards, fireplaces, and all the rest—into the rooms you have laid out on your plotting paper? All these cut-outs, like those on the opposite page, represent standard sizes drawn accurately to the scale of one-quarter of an inch to the foot. You will find it really fascinating to arrange and rearrange the cut-outs until each wall, window, fixture, and piece of furniture fits accurately in the exact place that pleases you most. If you should spoil one of the cut-outs or should require additional units, you can easily make extra ones, using these as models for measurement

Radio Control—the

You May Live to See Airplanes, Ships,

A Chauffeurless Auto

Pedestrians and motorists in London recently were mystified when this small car, without a driver or any visible means of control, threaded its way at fair speed through the traffic of Piccadilly Circus. Before long, Commander Green predicts, a business man, after driving to his office, may send his automobile back home by radio

By Lieutenant-Commander Fitzhugh Green, U.S.N.

WITH the advent of a successful gas engine 25 years ago came a myriad of automobiles and many thousands of airplanes. Gas engines brought cheap light and labor to the farm and swift transportation to the city, changing the lives of millions for the better. Now the second quarter of the century opens with a mechanical marvel that bids fair to outstrip even the gas engine in its profound effect upon human existence.

This marvel is *radiodynamics*—or, in simpler terms, *the science of remote control of motive mechanism by means of radio.*

There is no great novelty about radiodynamics. We hear little of this curious branch of radio engineering principally because all forms of wireless communication, especially broadcasting, have so strongly gripped the popular imagination. More than a quarter of a century ago an Englishman patented a scheme for wireless guidance of a self-propelled boat. In the past 10 years Nikola Tesla and John Hays Hammond, Jr., have built similar devices with complete success.

In the military world radiodynamics already has reached a practical stage. British and American navies both control crewless target vessels from a distance. A year ago the old U.S.S. *Iowa* fought her last action with our Pacific Fleet under such conditions. Radio-controlled submarines and torpedoes have been developed. On March 7, 1924, Captain Murphy, U. S. A., directed the first pilotless airship in this country at McCook field in Dayton, Ohio. On November 9, 1924, press announcements were sent out describing the perfection, by a famous Italian inventor, G. Fiamoa, of a radio device that directed the movements of a distant, rapidly moving submarine chaser, despite the most violent efforts at interference by shore stations.

IN ALL such automatons the motive power is self-contained. Radiant energy in large amounts is not yet practical. Gas, steam, or compressed-air engines drive the vehicle or vessel that is radio-controlled. All that radio does is to steer.

To understand more clearly the present circumstances surrounding radiodynamics it is worth while to glance for a moment at one or two outstanding facts of electrical development. In 1727, Stephen Gray, of London, astonished the world by passing an electric current over 700 feet of wire. But it was not until 1836 that Morse constructed his first telegraph. Note that he did not *invent* it. Rather should we say that he added a final touch to the combined efforts of the many deep-thinking scientific men who preceded him.

The art of distant control of mechanism by wire-carried current is technically known as "teledynamics." The great obstacle to the early development of this art was exactly that which now besets radiodynamics: not enough electrical energy survived at the far end of the system to do any useful work. It was only mankind's vigorous demand for telegraphy at a great distance that finally brought about the invention of the "relay."

A relay is a very sensitive but simple form of electric lever that responds to currents almost incalculably weak. It is the keynote of success for all systems involving the distant control of mechanisms. In wired systems it has enabled the mere pressure of a telegraph key, through which a few thousandths of an ampere flow to a distant relay, to start or stop the most powerful machinery, or to set off vast charges of explosive. Such mechanisms as electric bells, fire alarms, electric clocks, and telephone signals all are samples of teledynamics.

AS SOON as wireless systems came into use, inventors began experiments to find out whether relays couldn't be operated by radiant energy. Not only

Farming by Radio

Commander Green's conception of the farmer of the future cultivating his fields by radio. Resting comfortably in a cool control tower, he merely touches switches to make tractors obey his will

Marvel of the Future

Autos, and Tractors Governed by Wireless

electric oscillations, but other forms of ether waves were used. Great encouragement was given a few years ago by the development of highly sensitive devices for detecting heat waves. Doctor Coblentz of the Bureau of Standards in Washington contrived a "microradiometer," as he called it, that would detect the heat of an ordinary candle at a distance of 53 miles! Edison produced what he termed a "tasimeter," so sensitive that a person 30 feet away could produce a perceptible effect on it simply by turning his face toward the instrument. From such inventions rose wild stories of reading signals from distant stars and of rendering an enemy helpless by "death-dealing rays."

BUT the same trouble that baffled early attempts to perfect the telegraph still stood in the way of utilizing radiant energy—despite marvelous sensitiveness, not enough energy reached the receiving station to do any good. Whereas in the wired telegraph it was possible to transmit at least one-thousandth part of the applied power, in radio only about *one ten-trillionth* of the current sent out ever reached the receiving station.

Such minute quantities of current are adequate to make signals so audible that a well made telephone will respond under an impressed electromotive force of less than one-millionth of a volt. But the best relay that ever has been built probably would not trip with anything less than one thousandth of a volt, or a thousand times as much energy as the telephone needs. And when this relay is situated in a plane or ship, the unavoidable vibration is so great that the device has to be made much stiffer so that it will not operate without pressure from the radiating station. Thus, a receiving set for ordinary signals or broadcasting is commonly considered about 5000 times as efficient as one intended for use in radiodynamics.

However, despite this tremendous handicap, there really has been a rapid and successful development of radio control in the past few years. So far, distances involved have not been great; but they are increasing all the time. Marconi, for instance, predicts a range of more than 1000 miles for pilotless planes within the next few years.

The principle of radio piloting is very simple to understand. A human pilot or a helmsman pushes his rudder to left or right when a tiny spark of infinitesimal mental energy releases the waiting power stored up in his obedient arm. Radiodynamic control is exactly like that. A small motor or compressed - air cylinder, corresponding to the helmsman's arm, is connected with the rudder. A very delicately balanced electrical relay releases this mechanical "helmsman's arm" when it receives the incoming radio impulse for which it is tuned. Such an impulse is analogous to the mental will power darting by way of motor nerves to the human arm.

A Pilotless Boat

J. Elliott Jenkins, Chicago wireless engineer, is shown here with a model of his new radio-controlled steamboat, exhibited at a recent radio show. Some day, says Commander Green, every lake and bay and sea may contain many thousands of similar marine automatons

Radiodynamic control is exercised in a variety of ways, all of which fall into one of two classes: Either there is a separate receiving set for each steering unit or there is a selector system like that used for our automatic telephones.

IN EITHER system the automatic boat, tank, torpedo, or plane is released from human control with engines running and rudder amidships. If the automaton is to remain in sight of its operator, it runs on its original course until he decides to change. Suppose the boat must avoid a reef or the plane regain lost altitude due to striking an air pocket. The operator simply presses his key controlling the relay for up or down, right or left rudder, and the distant mechanism instantly responds. Springs bring the rudder back to amidships when the operator's key is released.

Use of gyroscopic stabilizers in addition to radio control assures a steadier course. For the long traverse of tank or torpedo, or the great overland flight of a plane, such stabilizers are indispensable. Roughness of terrain, adverse currents in the water, and wind squalls in the air all fight for possession of the pilotless machine.

It should be noted here that scientists at work on radiodynamics are in no sense parties to research of what is popularly called the "death ray." In radiodynamics are utilized only those well-known vibrations of the ether that nightly bring us broadcast programs on our home receiving sets.

In this connection, Nicolet, the well-known French airplane engineer, says of *stopping* motors at a distance by radio: "An electric wave such as is given out by an antenna loses its intensity very rapidly, its force varying as the square of the distance. The impulse created by a

(*Continued on page 170*)

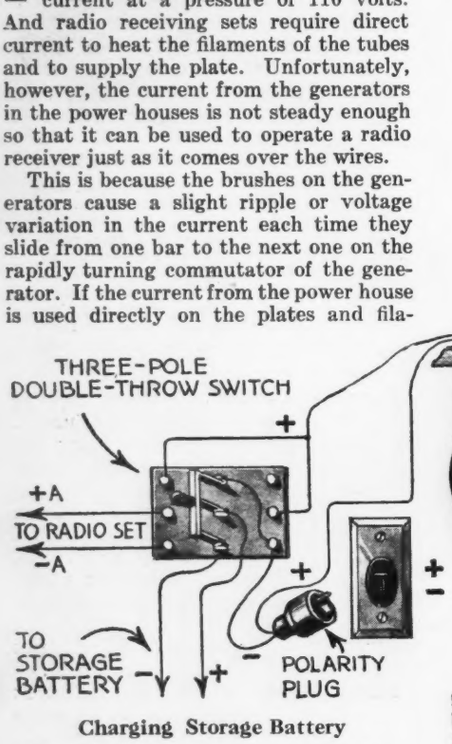
How to Run Your Receiver on 110-Volt Direct Current

A Practical Way to Cut Down the High Cost of Batteries

By Alexander Senauke, M.E.

IN A number of our larger cities, the electric-light service is run by direct current at a pressure of 110 volts. And radio receiving sets require direct current to heat the filaments of the tubes and to supply the plate. Unfortunately, however, the current from the generators in the power houses is not steady enough so that it can be used to operate a radio receiver just as it comes over the wires.

This is because the brushes on the generators cause a slight ripple or voltage variation in the current each time they slide from one bar to the next one on the rapidly turning commutator of the generator. If the current from the power house is used directly on the plates and filaments of the radio set, these small ripples or waves will be magnified so that the loudspeaker will reproduce a high pitched hum loud enough to drown out the music or speech.



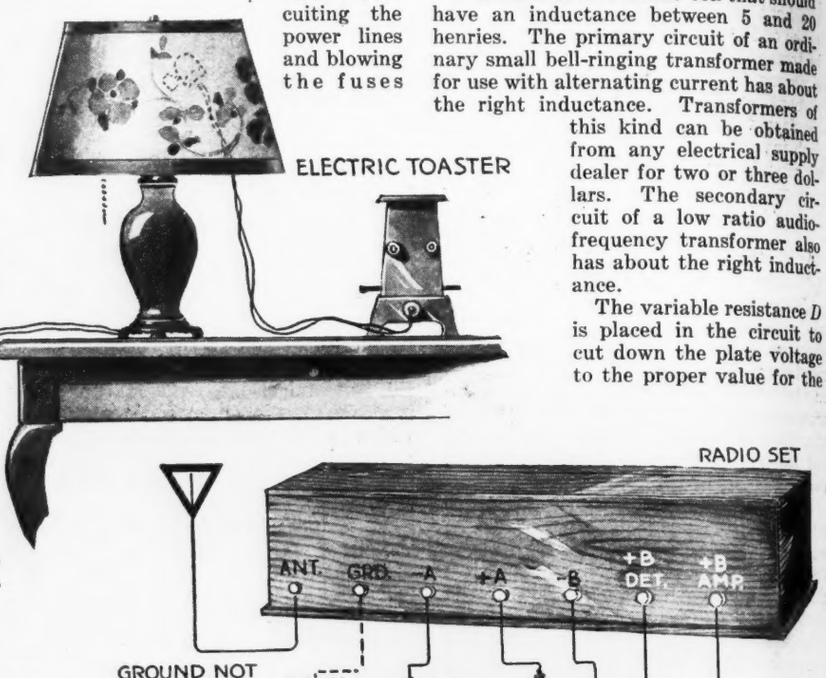
Charging Storage Battery

Fig. 1. Hook-up for charging radio-storage battery with 110-volt direct current from house-lighting circuit. If you find you are taking more current out of the battery than you are putting in, it is easy to insert an electric toaster in place of the lamp bulb, as indicated in the center illustration above

THE problem is to filter out the ripples from the current supply before it reaches the radio receiver. This can be done in a variety of ways.

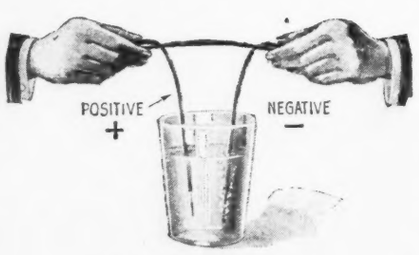
Figure 2 shows how to use the light current as a substitute for the B batteries, which represent the largest item in the upkeep cost of the radio receiver, particularly if it is a large set employing five or more tubes. In the diagram it will be noted that the ground connection is marked "*Not* required." This is because the ground connection already is made for you through the power lines, since the −B terminal in practically all hook-ups is connected with the +A terminal, and in a great many receivers the filament circuit is connected at some point with the wire that goes to the ground binding post.

If you have a receiver in which the antenna circuit is completely isolated from the other wiring in the set, you will need to use the ground connection in the usual way, but it is well to insert a half-microfarad condenser in series with it to prevent short-circuiting the power lines and blowing the fuses should you be mistaken about the internal connections of the receiver.



Battery Substitute

Fig. 2. How to use the direct light current as a substitute for radio B batteries. Notice that no ground connection is required in this set



The Polarity Test

Fig. 3. How to determine which end of the light circuit wire is positive and which is negative. Dip the two bared ends of the wire into a glass of water into which a pinch of table salt has been stirred. Bubbles will form from one end of the wire. This always is the negative

A and *B* in the diagram are fixed condensers with a capacity of from 2 to 4 microfarads apiece. Condensers such as are used in telephone work are satisfactory, and the radio supply dealers carry other styles that are equally good.

C is an iron core choke coil that should have an inductance between 5 and 20 henries. The primary circuit of an ordinary small bell-ringing transformer made for use with alternating current has about the right inductance. Transformers of this kind can be obtained from any electrical supply dealer for two or three dollars. The secondary circuit of a low ratio audio-frequency transformer also has about the right inductance.

The variable resistance *D* is placed in the circuit to cut down the plate voltage to the proper value for the detector tube. It should have a maximum-to-minimum range of 100,000 down to 5000 ohms.

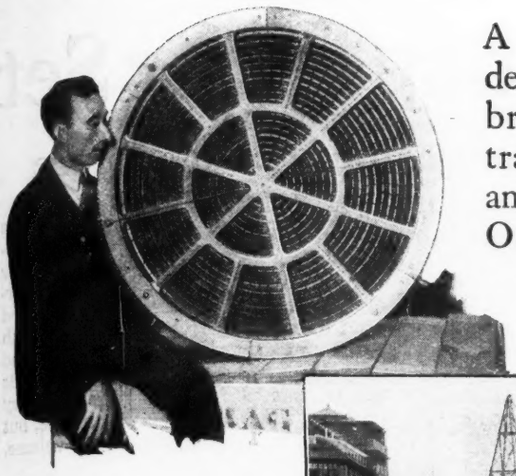
ALL things considered, Fig. 2 represents the best and simplest way to utilize direct current power service to operate the radio receiver. It is true that the *A* battery has not been eliminated, but it is so easy to recharge a storage battery when direct current is available, that it hardly pays to try to work out a circuit that will eliminate this battery, especially since no one yet has succeeded in figuring out a filter circuit that will eliminate both A and B batteries without also making alterations in the wiring of the receiver itself.

In Fig. 1 is shown an arrangement that will result in keeping the A battery

(*Continued on page 172*)

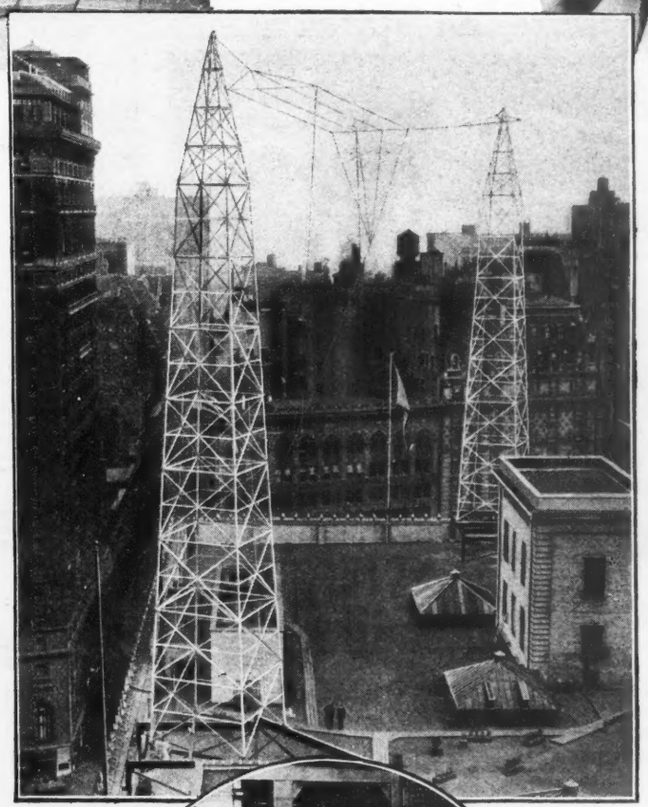
Novelties of Radio in Pictures

A huge loudspeaker designed for public broadcasting—Lofty transmitting towers among skyscrapers—Odd miniature sets



A Powerful Speaker

Here is an enormous loudspeaker just designed by C. W. Hewlett, of Schenectady, N. Y., for use in public broadcasting. The construction is unique in that no permanent or electro magnets are used. Instead, the diaphragm is operated by the induced currents generated in the diaphragm itself by coils of wire placed directly in front of it. Those who have heard this loudspeaker in operation say it reproduces voice and music with wonderful fidelity and clarity



A Toothbrush Set

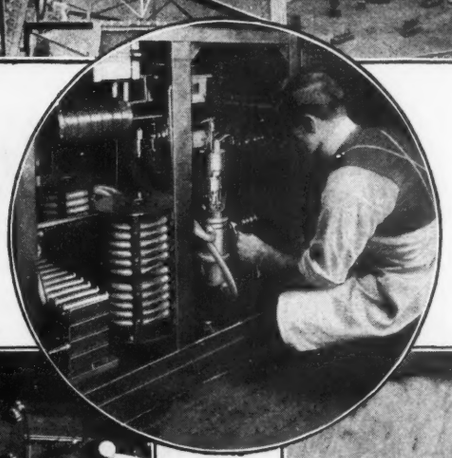
The craze for miniature radio receivers still continues. One of the latest novelties, built by William L. Wray of New York City, uses the handle of a toothbrush as a base. The picture shows the designer with his midget set

307-Foot Towers

Station WGBS in New York City lays claim to the tallest antenna towers in the eastern section of the country. The tops of the towers are 307 feet above the ground and 107 feet above the roof of the building containing the broadcasting station. Even at this height they are lower than the roofs of many of the skyscrapers surrounding them

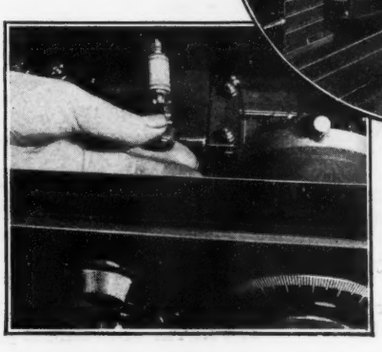
Cooling Tubes

Few broadcast listeners realize that the most important problem confronting the designer of high power transmitting tubes is how to keep them from burning out from heat produced in operation. Water-jacketed tubes offered the obvious solution, but it was not until lately, when radio engineers worked out a system of choke coils in which the rubber tubing containing the water supply was used as wire, that this system was found practical. Water is a fair conductor of high frequency current, but it cannot get through a column of water arranged like a coil of wire, as shown in the circular illustration



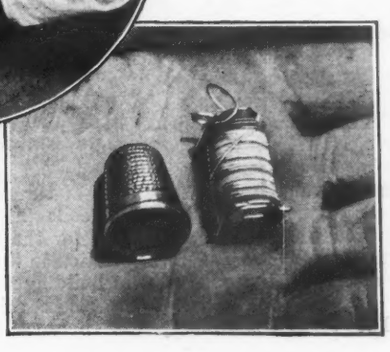
One Way to Cure Distortion

It is much better to build a radio receiver that does not distort, but if in spite of your best efforts to get transformers that will give you the proper quality, you still notice some distortion, a variable resistance connected across the secondary terminals of the audio-frequency transformer often will work wonders with the quality



Thimble-Size Crystal Set

Another miniature crystal set, recently built by Jack Duffy of Sydney, Australia, is hardly larger than the thimble pictured beside it. This receiver is wound with 30 feet of No. 36 wire. The builder says he has been able to hear a number of different local stations with it. Tuning is accomplished by means of tiny taps on the side of the coil



How to Build A Two-Tube Loudspeaker Set

New Type Reflex Gives Ample Volume on a Single Tube

By Alfred P. Lane

HERE is a radio receiver designed to give plenty of volume on the loudspeaker with the minimum number of tubes. If you are located near several powerful broadcasting stations, this receiver will give volume enough for dancing from any of them on just one vacuum tube. And if you are a bit too far away for one tube, the design of the receiver is such that you can add another stage of audio amplification without changing a single wire already in the set.

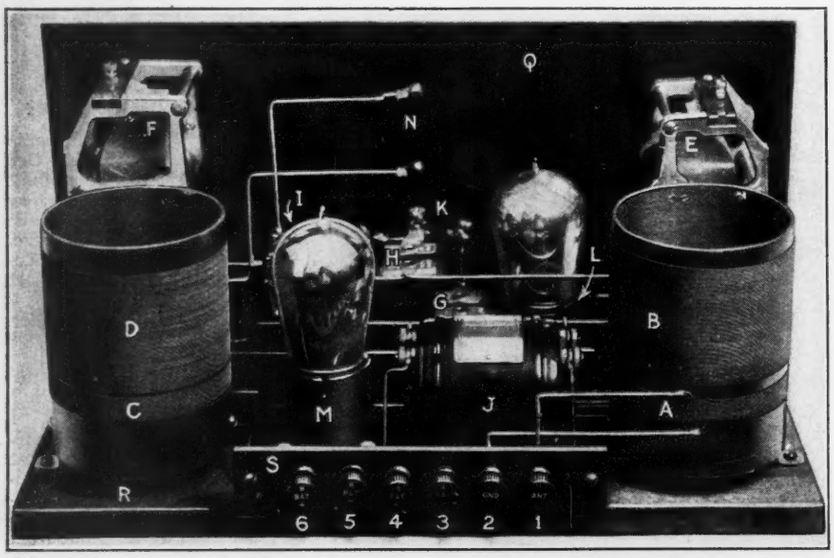


Fig. 1. Rear view of the set, showing layout of parts and wiring. Notice particularly how the ends of the wires are fastened on coil *A*

FURTHERMORE, the arrangement of the parts is equally symmetrical, whether one or two tubes are used.

The receiver is both selective and easy to tune. If the coils are carefully wound and the two condensers are alike, the two tuning dials will read within a few degrees of each other from the lowest to the highest of the broadcasting wave lengths, and the readings of these dials may be logged for the different stations heard.

With the receiver shown in the illustrations, I have found it easy to tune in any one of the 11 different broadcasting stations in the vicinity of New York City on one tube with loudspeaker strength, using a 100-foot antenna strung up the side of an apartment house. The selectivity can be adjusted to suit local conditions and various lengths of antenna by changing the number of turns in coil *A*.

Another feature that certainly will appeal to radio fans is the elimination from the circuit of any special parts not easily obtained. The tuning inductances *AB* and *CD* take the place of the fancy coupling units often recommended for reflex sets and these inductances are so simple that any one can wind them. And it is an easy matter to change the number of turns of wire in any of the coils in order to compensate for the peculiarities of the particular instruments you use in building the receiver.

The reflex principle is employed because it reduces the number of tubes required to obtain the desired degree of volume, a factor of considerable importance when the receiver is to be operated on dry cells, or on a storage battery if the latter must be carried some distance to have it recharged. With two storage-battery tubes, it will overload most loudspeakers on local stations. It will operate perfectly on storage-battery tubes or either type of dry-cell tube, but the latter will not give as much volume.

THE crystal detector helps to keep the quality of the reproduction high, although this is governed to a large extent by the characteristics of the audio-frequency transformers used in the circuit.

Here are the parts you will need:

A and *B*—Tube tuning unit
C and *D*—Crystal tuning unit
E and *F*—Variable condensers, .00025 mfd. maximum capacity
G—Mica fixed condenser, .001 mfd.
H—Mica fixed condenser, .00025 mfd.
I—Audio-frequency transformer, high ratio
J—Audio-frequency transformer, medium ratio
K—Rheostat
L and *M*—Vacuum-tube sockets
N—Crystal detector
O—Double-circuit jack
P—Open-circuit jack
Q—Panel, 7 by 14 inches
R—Wooden base board, 6½ by 13½ inches
S—Binding-post panel, 1 by 6 inches
Six binding posts, two dials, two vacuum tubes, brass right-angle brackets, bus wire, etc.

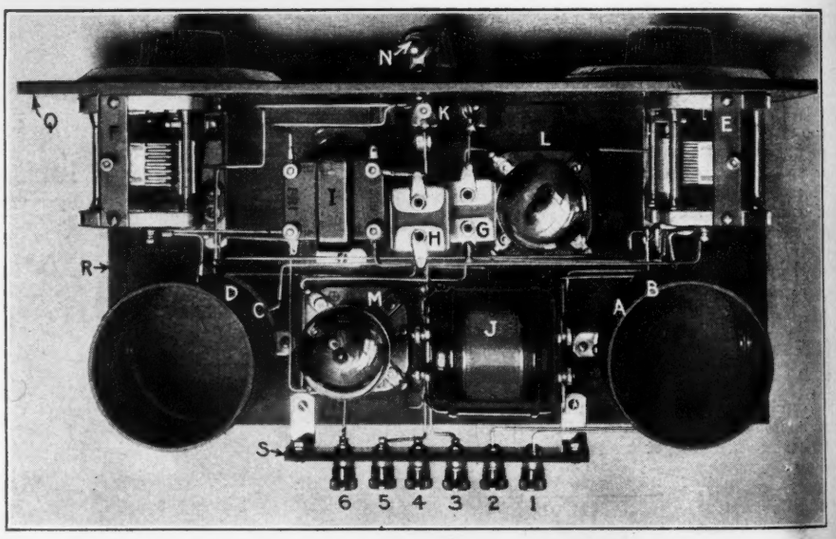


Fig. 2. View of the set from above. The layout of parts is symmetrical, whether you use one or two tubes. For a one-tube set, leave out tube socket *M* and audio transformer *J*

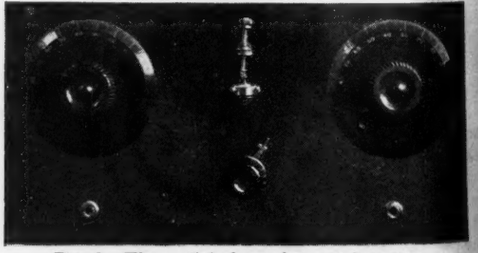


Fig. 3. The well balanced panel layout

The variable condensers *E* and *F* do not have to be of .00025 capacity. If you already have a couple of .0005 condensers, they can be used. It is desirable, however, if larger condensers are used, to cut down the number of turns in coils *B* and *D* to 50 turns apiece so as to spread out the broadcasting stations over a greater portion of the dials.

THE audio-frequency transformer *I* has a ratio of 5 to 1; transformer *J* has a ratio of 4½ to 1. Almost any standard types of transformers can be used, although it may be necessary to alter the number of turns in coil *C* if the characteristics of the transformer used at *I* are different from the one used in the model set. How to do this will be explained later.

If preferred, the crystal detector *N* can be of the fixed type, but one can never be sure that a fixed crystal is really sensitive unless means are at hand to make comparative tests.

The jacks *O* and *P* in this receiver are of the type that have holes drilled and tapped in the frame, and the wooden baseboard is screwed directly to the jacks as shown in Figs. 4 and 5. If you have standard jacks on hand, you can drill and tap the holes yourself; or if you prefer, the wooden base can be fastened to the panel in the usual way with screws through the panel.

The rheostat, of course, should have a resistance suitable for the tubes you expect to use. Generally speaking, any rheostat that is right for one particular tube will also handle two tubes in parallel without enough overheating to make it a serious matter.

The rest of the apparatus needs no comment. Any standard parts will give excellent results.

After you have purchased all the parts, including two pieces of bakelite tubing 4 inches long and 3 inches in diameter, and a half-pound spool of No. 22 double silk-covered wire for the inductances *AB* and *CD*, the first step is to lay out the holes in the panel as shown in Fig. 7. Only the shaft holes for the instruments are indicated, since there is so much variation in the spacing of the holes for the screw used to mount the instruments, and so many of them are now made single mounting anyway.

The easiest way to do this job is to mark off the holes on a piece of paper the exact size of the panel and paste the paper on the panel with library paste. Then center punch the holes through the paper and after you have drilled them, the paper can be washed off. This method will prevent scratches on the panel.

The tuning inductances should be wound next, after the holes have been drilled in the bakelite tubing for the brass angle brackets that support them, as shown in Figs. 1, 2, 4, and 5. Small holes also should be drilled so that the ends of the wire can be passed through and back to hold them in place. The way this is done is shown on coil *A* in Fig. 1.

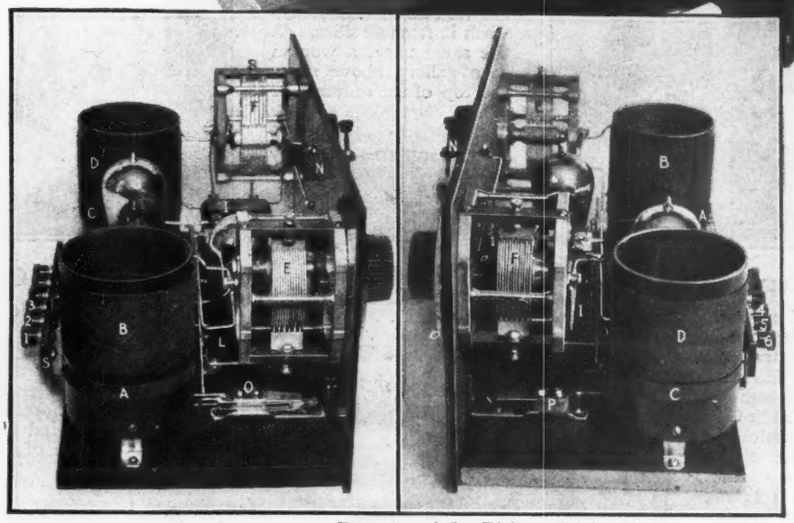
THE number of turns of wire in each coil is as follows: Coil *A*, 14 turns; coil *B*, 72 turns; coil *C*, 15 turns; coil *D*, 72 turns. Coils *A* and *C* take up slightly less than a half inch of space on the bakelite tubing, and coils *B* and *D* are a shade over 2 inches long.

Now arrange all the instruments as shown in Figs. 1, 2, 4, and 5 after you have mounted the panel on the wooden baseboard. Mark where the holding screws belong and fasten all the instruments in place except the tuning inductances *AB* and *CD*. It is best to leave these off until the wires in back of them have been soldered in place. This will save accidental scorching of the coil wire and will give more space to work.

(Continued on page 174)

Easy to Tune

Mr. Lane tuning the remarkable loudspeaker set that he tells you how to build in the accompanying article. For local stations this set will give ample loudspeaker volume to fill a room on a single tube



Figs. 4 and 5. Right and left end views, showing the position of parts, and particularly how the wooden baseboard is screwed to the jacks; also how the tuning inductances are mounted by brass right-angle brackets

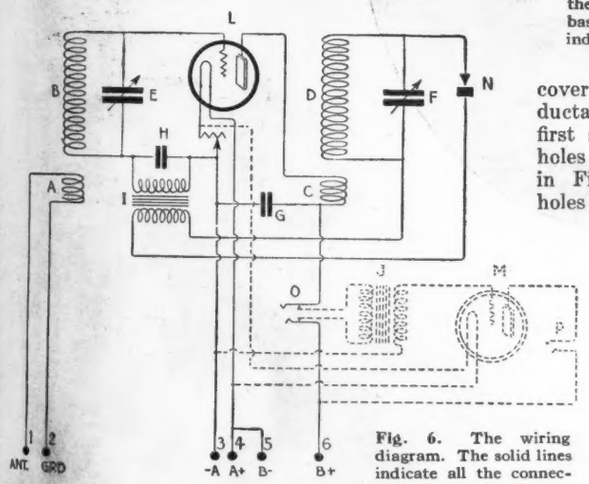


Fig. 6. The wiring diagram. The solid lines indicate all the connections for a one-tube set. The dotted lines show the additional wires necessary for two tubes

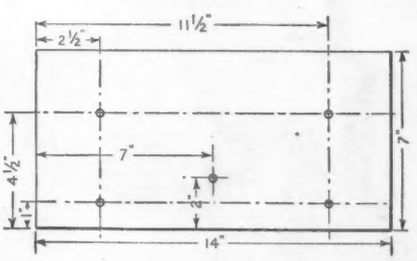
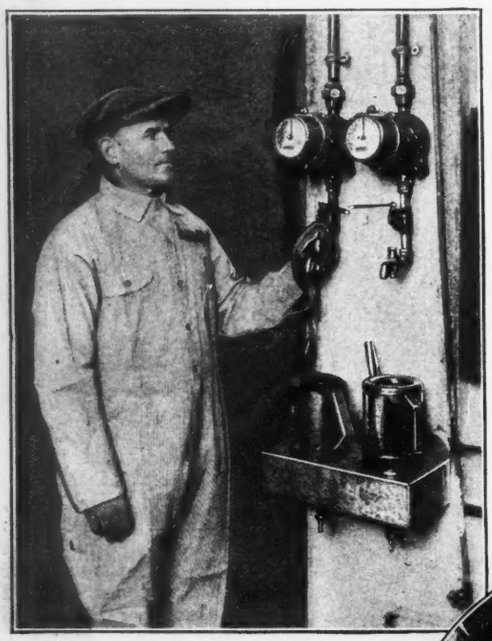


Fig. 7. The panel layout. The holes are for the shafts of the condensers, for the rheostat and for the jacks. If screws are needed to support the condensers, use the templets with them

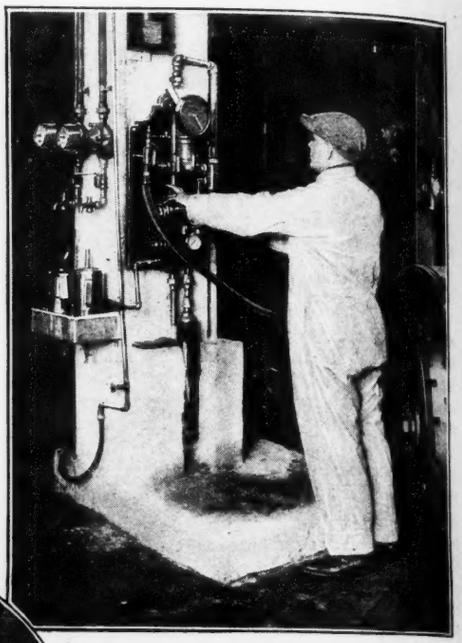
Better Service for the Motorist

Machines Deliver Gas and Oil—A New Auto Laundry



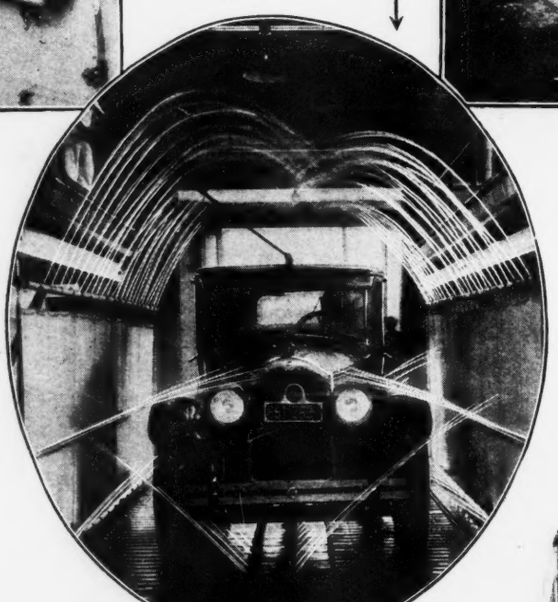
Auto Shower-Bath

From 11 to 14 minutes is all the time it takes to clean a car immaculately by an ingenious mechanical washing system adopted in a new $200,000 automobile laundry in Chicago, Ill. A 150-foot conveyor automatically carries each car through a series of washing and cleaning processes controlled by crews of men and women workers. In one of these processes the car passes through a shower bath, where sprays wash it from all sides. At the same time, a woman in a gallery above mops the top of the automobile



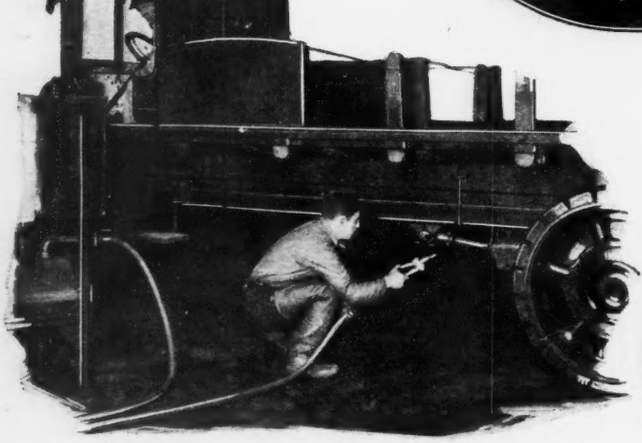
Mechanical Oil Service

Convenience, accuracy of measurement, elimination of waste, and speedy service to customers are combined in a newly invented mechanical oil-delivery system recently installed in a New York City garage. There two grades of lubricating oil are delivered simultaneously at two points on each of three floors, or six points in all. The system makes use of gravity and compressed air, the oil being stored in 550-gallon tanks in a fireproof room. The photograph shows two of the taps, each with an individual meter for measurement



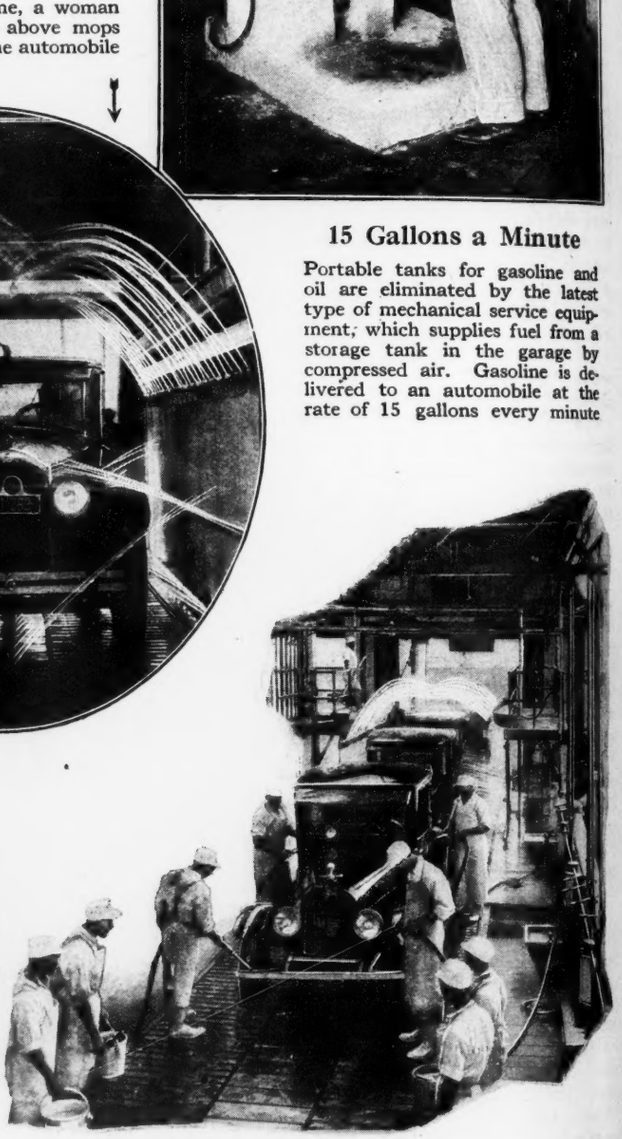
15 Gallons a Minute

Portable tanks for gasoline and oil are eliminated by the latest type of mechanical service equipment, which supplies fuel from a storage tank in the garage by compressed air. Gasoline is delivered to an automobile at the rate of 15 gallons every minute



Spray Cleans Off Grease and Dirt

Inaccessible parts of the chassis, such as the running gear and front and rear axles, now are cleaned quickly and easily by a new compressed-air mechanism that sprays a warm, soapy water solution under pressure to remove grease and dirt



Where Autos Are Groomed while You Wait

This view of the new automobile laundry in Chicago shows a crew of cleaners at work on a line of cars that have come in for a bath. Notice the pressure hoses for cleaning off grease and dirt. The cars travel on a rack with a variable speed control

Make Your Carburetor Save Money

Simple Adjustments Add Power to Your Car with Less Fuel

By E. B. Staples

THE mileage you get out of your gas, the power you get out of your motor, and the amount of general satisfaction you get out of your car depend on no one thing more than on a proper adjustment of your carburetor.

And yet, though this adjustment is one of the simplest that can be made on a motor-car, probably half the automobiles in daily use in America are being operated below their maximum efficiency because their carburetors are not sharply adjusted.

Now, aside from wasting gas, causing loss of power, and creating dissatisfaction, an improperly adjusted carburetor can do permanent damage to a motor. For it means carbon and carbon means knocks, vibration, and eventually ruined bearings, a granulated shaft, and shortened life for the motor. Also, small particles of carbon pass through the valve openings, and when the valves close on them, pits are formed and the valves must be ground.

One person only should adjust your carburetor—yourself. The reason is that you are constantly studying the action of your motor under varying conditions of driving. Hence, you know better than any one else wherein it fails, and what changes must be made to make it run better. Also, since you must drive the car, you are interested more than any one else in getting it to run perfectly.

UNLESS you chance to hit upon the right combination immediately, which is quite unlikely, you won't be able to adjust your carburetor correctly at the first attempt. Neither is the usual test for a carburetor adjustment—opening the throttle suddenly and observing whether the motor accelerates immediately — at all conclusive. When you have made an adjustment, you must test it where a motor test means something to you—that is, on the road—and you must repeat the test until you are satisfied that the adjustment is as nearly perfect as possible.

Not long ago I received direct from the factory a new seven-ton truck with a large motor. The carburetor was represented as being in perfect adjustment. I put the truck into service hauling lumber over a 20-mile route. The first round trip consumed about 18 gallons of gas. In a week or so, as the truck limbered up, the gasoline consumption for each trip had dropped to about 15 gallons, but its motor was knocking badly from carbon. Now, although many mechanics would have pronounced the carburetor adjustment good enough, I decided it could be made much better. After a week of careful adjusting and testing, the car was making its 40-mile trip with a consumption of only 9½ gallons of gas. Moreover, it was proving capable of hauling a load one-third larger than formerly. Its motor was free of carbon and running smoothly.

If such a marked improvement can be made with a heavy truck under arduous conditions of service, what can you do to your pleasure car, which you probably operate only smooth roads and under other favorable conditions?

A motor shows its maximum power with the carburetor adjusted to supply just enough gasoline to run the car without any excess to form carbon. When a motor "spits back" through the carburetor, it is a sign of too lean a mixture. When a motor is choked, runs irregularly, and emits black smoke, it is a sign of too rich a mixture. Somewhere between these two extremes is the point of maximum efficiency which you must seek.

ON MOST modern carburetors there are two adjustments, known as "high speed" and "low speed." You will find the location of these by referring to the instruction book that the manufacturer supplied with your car. With your motor warm, turn the low-speed adjustment until the motor idles with absolute steadiness. Retard your spark, and observe whether the motor still idles steadily at the lower speed. If it does not, turn the low-speed adjustment until it does.

Then drive up some hill, which you know your car can just about climb in high. If there is the least sign of irregular running, reduce the mixture at the high-speed adjustment and try again. Should the motor "spit back" in this trial, it will be necessary to enrich the mixture. Repeat these trials, adjusting to compensate for "spitting" or irregular running, until you are satisfied that the car is operating at its best. Then leave the carburetor at that adjustment, and don't change it until you are certain a change is necessary.

Never attempt to adjust the carburetor while the motor is cold. The adjustment should be made for normal running conditions, which means for a warm motor. Remember, too, that the closer you approach the point of maximum efficiency, the finer will be the adjustments necessary after each test.

Useful Pointers to Remember

DON'T leave your carburetor adjustment to some one else. Do it yourself.

Don't expect perfect results at once.

Make your tests on the road under actual driving conditions. Simply opening the throttle is not enough.

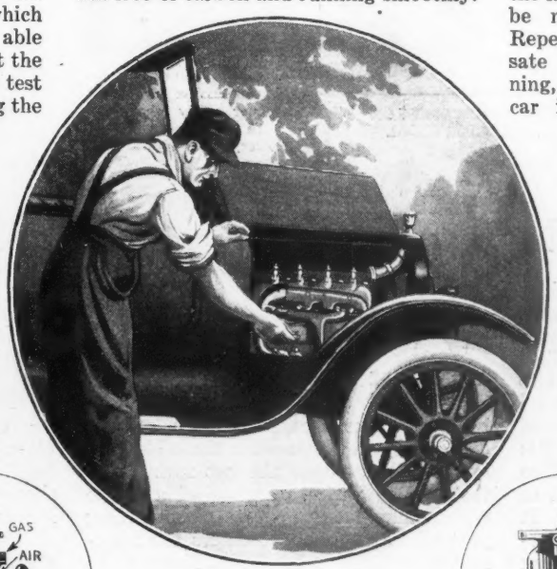
Remember that your carburetor should supply just enough gas to run the car without forming carbon.

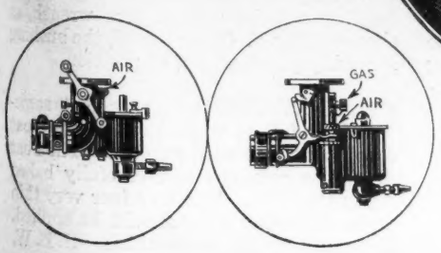
When the motor "spits back," the mixture is too lean.

When it runs irregularly and emits black smoke, the mixture is too rich.

Don't try to make adjustments when the motor is cold.

Keep a careful record of your mileage and gasoline consumption.





Make your own carburetor adjustments. Here are four standard types of carburetors, one of which probably is on your automobile. Controls for fuel mixture are indicated at the left and right

Money-Saving Auto Kinks

A Bed for Touring

and Six Other Aids

OVERLAND auto travel calls for light and compact equipment. Why not, therefore, utilize the seat cushions as a bed? They combine spring and mattress and must be carried anyway.

By making a framework as illustrated in Fig. 1, one Californian autoist and his wife converted their car for sleeping and used it satisfactorily in a trip across the continent to Vermont.

When the frame is set up, the cushions are placed on it so that they meet on the center cross strip. The main weight of the sleeper's body comes on the springy cushions, while his feet are supported by an easily adjusted canvas hammock. This is made from a 40-in. width of canvas, long enough to reach from the windshield bracket in front to the top hangers in the rear. Each end is turned over a 1 by 2 in. wooden strip and sewed. The canvas is tied in position at each corner with a small rope.

When packed, the framework is wrapped in the canvas, making a neat roll about 40 in. long and 6 in. in diameter. — A. MAY HOLADAY.

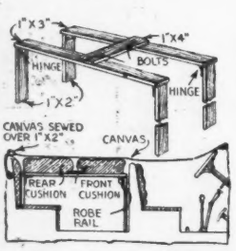
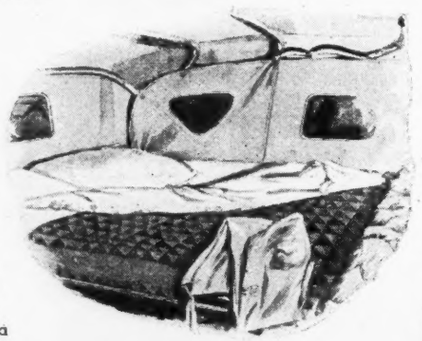


Fig. 1. Auto cushions used for bed on overland tour



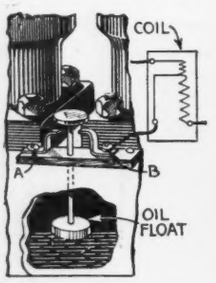
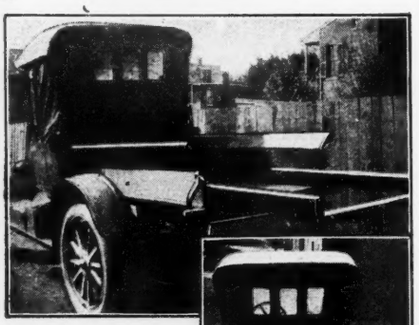


Fig. 2. Motor stops when the oil runs low



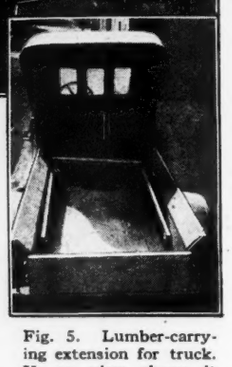


Fig. 5. Lumber-carrying extension for truck. Upper view shows it with rack extended; lower, folded within body

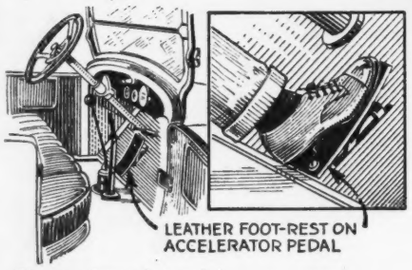


Fig. 4. Cover for pedal

IN SPITE of the care motorists give to the oil level in the crankcase of their car and the various oil gages and warning devices in common use, the burning out of bearings is still a relatively frequent mishap.

It is quite possible, however, to make a warning device that will stop the motor when the oil level becomes dangerously low. A ¼-in.-thick piece of fiber is drilled as in Fig. 2 to allow the oil-float rod to pass through. At a slight distance from the float-rod hole other holes are drilled for the screws *A* and *B*. The one for *B* is countersunk on the under side. Two brass or copper strips are then bent as shown and fastened under the screws. It is a wise precaution to fill the countersunk hole for screw *B* with sealing-wax after the clip has been fastened in place. The fiber block now may be attached to the motor by screw *A* and another screw at the other end.

As the motor is grounded, screw *A* and its clip are grounded. A metal washer of brass or copper is fastened to the float rod and so adjusted that when the oil level is low it will rest upon the two spring contacts. The wiring consists of a single wire running from *B* either to the binding post where the current enters the interrupter, or to the coil.—R. H. KASPER.

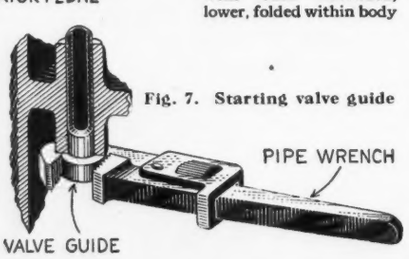


Fig. 7. Starting valve guide

AN AUTOIST fashioned a handy clip to hold his tire gage just inside the door pocket. A piece of light but stiff sheet brass, 1 by 3 in., with corners rounded and edges filed smooth, was bent into a shape (Fig. 3) to fit on the edge of the door lining. A flat-head brass bolt, ¼ by ⅛ in., first was screwed into place, the projection beyond the nut noted, and the bolt removed and filed down to exactly the right size. The rim on the gage prevents it from dropping.—R. C. T.

A RETIRED army officer in Washington has fitted the accelerator of his auto with a cover flap of stiff sole leather about 4 by 7 in. (Fig. 4). The advantage of this is that it distributes the pressure and also reduces the likelihood of his foot's slipping off the pedal. The leather does not interfere with the removal of the floorboard, as it is pliable enough to be bent back and out of the way of obstructions.—G. A. L.

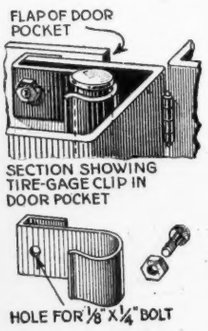


Fig. 3. Brass holder keeps tire gage handy

TO ADAPT a Ford truck with a short body for carrying lumber, my father build a frame extension, as shown in Fig. 5. It is made of 1½ by 3¾ in. lumber, fastened with ½-in. bolts and pivoted to the sides of the truck body. — JANET LINEBAUGH.

WHEN a large screwhead breaks, it is often possible to remove the screw by drilling a small hole diagonally into the slot and inserting the tang of a file or other tool to act as a lever, as in Fig. 6. When screws are to be inserted in a deep recess or in any very awkward or inaccessible place, it is possible to fasten the screw to the tip of the screwdriver with a drop of solder. In some cases, as in repairing the oil circulating system of certain truck cylinder blocks, this method is used in conjunction with special screwdrivers of long reach made, as shown in Fig. 6, from cold rolled steel.

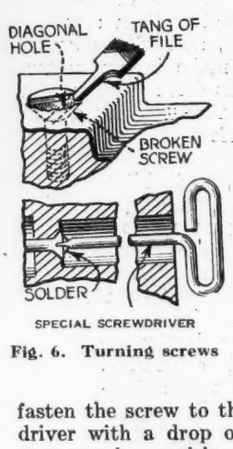
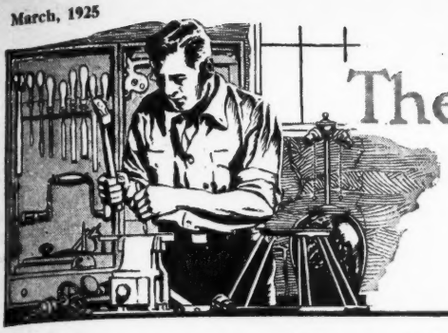


Fig. 6. Turning screws

THE removal of valve guides from the cylinder castings of the automobile often may be accomplished by giving the bushing a twist with a pipe wrench, as shown in Fig. 7. Once started, the bushing is readily punched out of position.

CARBURETORS with cork floats sometimes fail to work because the float becomes soaked with gasoline. The float should be removed and carefully baked dry in the oven. Three or four very thin coats of shellac then should be applied. Do not get shellac on too thick.—H. L. W.



The Home Workshop

Arthur Wakeling, Editor

Easy to Build Fast Model Airplane

World Champion Tells How to Construct Miniature Aircraft

By Robert V. Jaros

ALL-AROUND flying performance is what affords the greatest satisfaction in a model airplane. The exact model of a large machine may have an excellent appearance, but be a very poor flier. Consequently the twin pusher model illustrated is my favorite because it embodies in its simple and sturdy construction the qualities of a consistently dependable flier.

The lack of tools is not a handicap in model airplane building. Very good construction can be obtained by using only a pocket knife, a small block plane, a candle, and a pair of pliers. The block plane need be no larger than the 1-in. size, which can be bought very cheaply.

The materials are simple and inexpensive. Bamboo, white pine wood, glue, silk thread, steel piano wire No. 13, tissue paper, "banana oil," ⅛-in. washers, and rubber are all that are necessary. The best bamboo is that which has a glossy outside surface and joints that are far apart.

Dress spangles, which may be bought in the fancy goods department of a dry-goods store, serve well as washers. Banana oil may be bought by the ounce at almost any drug-store.

The A-shaped frame is composed of two main beams of pine, 9/32 by 3/32 by 36 in., braced by a series of bamboo cross pieces. The beams should be planed down and sandpapered smoothly to the correct size, and then small slits, through which the cross braces will extend, should be made in them. It is easiest to make these slits by laying the beams flatly on a board and forcing the point of a small knife blade carefully into the wood (No. 1, Fig. 2, page 128).

The ends where the beams will meet should be cut on a bias to insure a close fit. After this has been done, force a wire hook, made with the pliers, over the ends, and glue and bind with silk thread, as in No. 2, Fig. 2.

On all constructions glue should be applied before the thread is wrapped around. The binding should be tight and the thread tied.

The cross braces are cut out and shaved down with a knife from a larger piece of bamboo. They should be cut so that one of the wider surfaces is of the glossy outside part because the greatest strength of bamboo lies in this part.

The cross braces at the widest part of the frame, that is, the rear of the model,

(Continued on page 128)

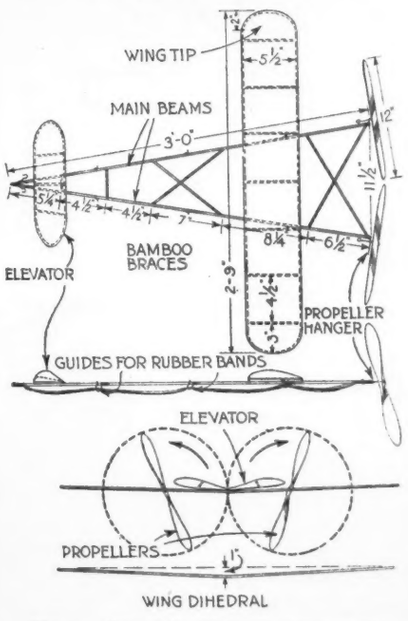
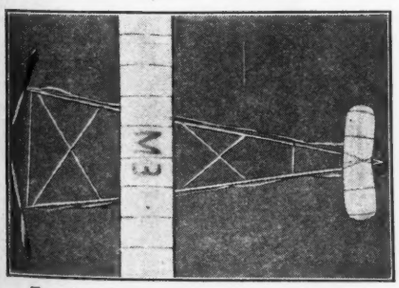


Fig. 1. Top, side, and rear views of the model, and diagram illustrating wing dihedral



Top view showing main beams, braces, and location of wing, elevator, and propellers

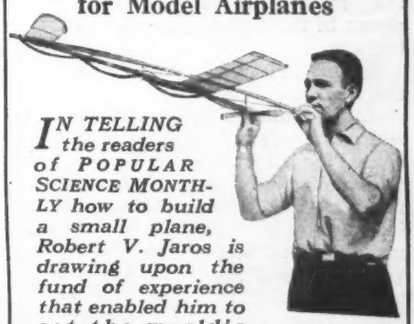
Where to Find This Month's Mechanical Features

The Home Workshop
Pages 97 to 140

The Shipshape Home
Page 142

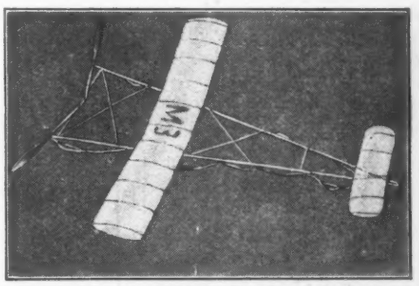
Better Shop Methods Department
Pages 102 and 144 to 158

Jaros Holds World's Record for Model Airplanes



IN TELLING the readers of POPULAR SCIENCE MONTHLY how to build a small plane, Robert V. Jaros is drawing upon the fund of experience that enabled him to set the world's record for model flying. Representing the Illinois Model Aero Club in competition at the last great international air meet at Dayton, Ohio, he won the Mulvihill trophy for that organization. His model remained in the air 10 minutes, 14.2 seconds, and traveled about two miles.

Jaros, who is 19 years of age, is a student at the University of Michigan.



In flight, the elastic-driven propellers push this little monoplane model from the rear

A Decorative Desk for Your Home

How You Can Construct an Unusually Beautiful Piece of Furniture

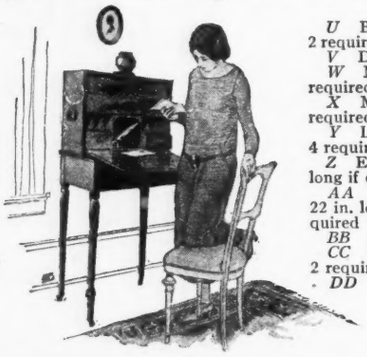
IF YOU have made some of the simpler pieces of furniture described in the Home Workshop, you are perhaps ready to try your hand at something a little out of the ordinary. Such a piece is the beautiful writing-desk detailed in the accompanying drawings.

The design is based upon an early American desk of Sheraton influence in the Metropolitan Museum of Art, New York. Some modifications in size and detail have been made by George F. Kaercher, the furniture-factory superintendent who prepared the working drawings, in order to adapt the desk better to modern purposes. The style nevertheless remains essentially that of the magnificent model shown in the central photograph.

If made of mahogany, the decorative bandings should be walnut veneer and conversely, if walnut is used for the main parts, the bandings should be of mahogany. The box part, including the front, is made of ⅞-in. thick 5-ply veneer, if obtainable, and a special effort should be made to select for the front a piece having a face veneer of rich and striking figure.

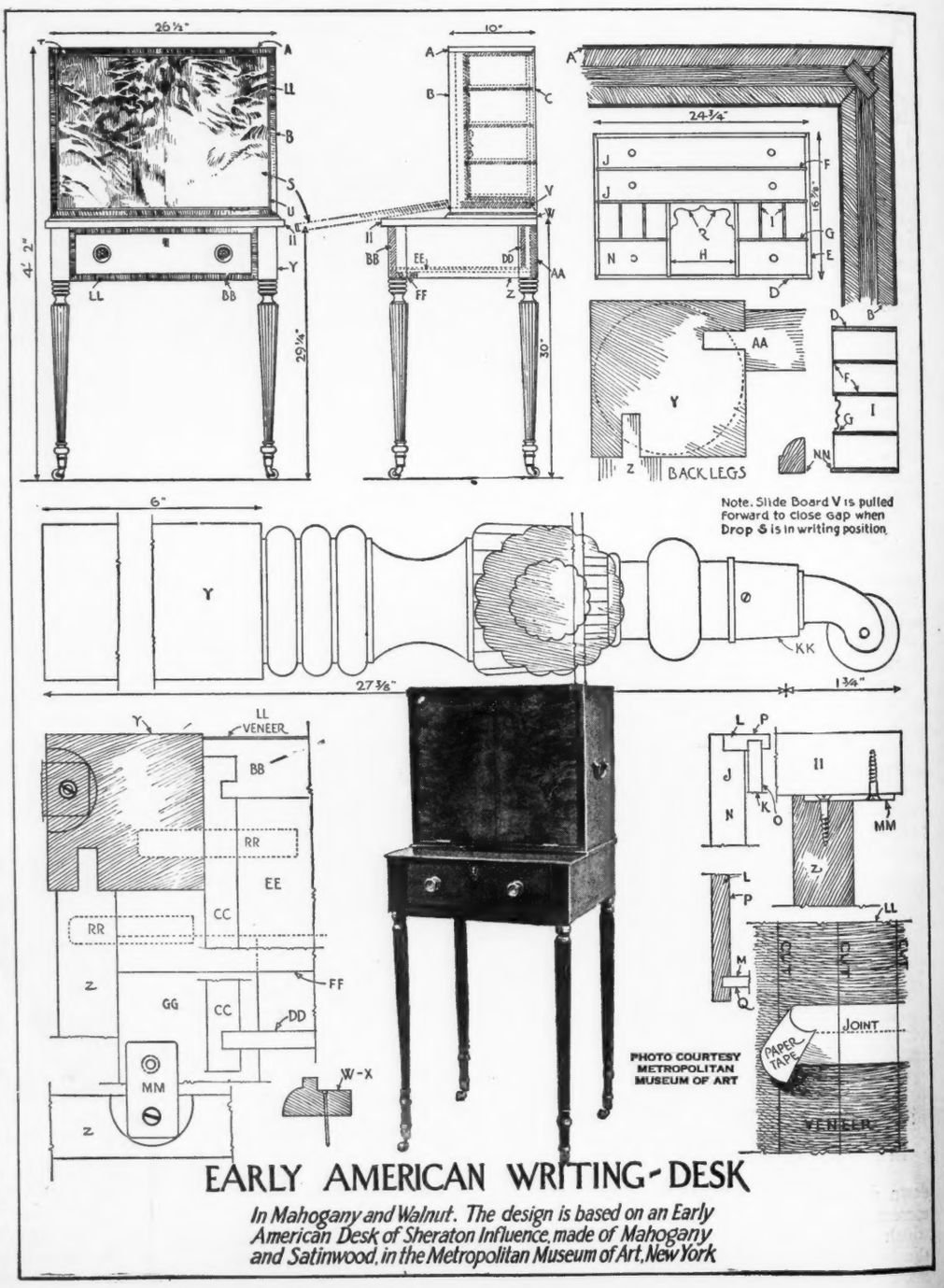
Any one who has had sufficient experience to build this piece, will find that the working drawings show practically all that need to be known about the construction, when taken in conjunction with the following bill of materials. The stock is either mahogany or walnut, except where otherwise noted.

A Top and bottom of desk, ⅞ by 10 by 26½, 5-ply (or solid), 2 required
B Ends of desk, ⅞ by 10 by 19⅝, 5-ply (or solid), 2 required
C Back of desk, ⅜ by 26¼ by 19⅝, 3- or 5-ply, 1 required
D Top and bottom, interior, ½ by 8 by 24¼, whitewood, 2 required
E Ends, interior, ½ by 8 by 16⅞, whitewood, 2 required
F Shelves, interior, ¼ by 8 by 24¼, 2 required
G Shelves, interior, ¼ by 8 by 8¼, 2 required
H Partitions, interior, ½ by 8 by 8¾, 2 required
I Partitions, interior, ¼ by 8 by 4¼, bandsawed, 4 required
J Drawer fronts, interior, ½ by 3½ by 24, 2 required
K Drawer backs, interior, 3/16 by 3⅛ by 23¾, 2 required
L Drawer sides or ends, interior, ¼ by 3½ by 7¾, 4 required
M Drawer bottoms, interior, ⅛ by 7½ by 23¾, 2 required
N Drawer fronts, interior, ½ by 4 by 8, 2 required
O Drawer backs, interior, 3/16 by 3⅝ by 7¾, 2 required
P Drawer ends, interior, ¼ by 4 by 7¾, 4 required
Q Drawer bottoms, interior, ⅛ by 7½ by 7¾, 2 required
R Center brackets, interior, ¼ by 3 by 4, 2 required
S Desk front or drop, ⅞ by 17⅝ by 24½, 5-ply (or solid stock with mitered end battens), 1 required
T Bead molding on edges, ⅛ by 1 1/16 by 24¾, 2 required



U Bead molding ends on edges, ⅛ by 1 1/16 by 17⅛, 2 required
V Desk slide board, ⅞ by 8¾ by 24 11/16, 1 required
W Molding, top of base (mitered), ½ by 1 by 27⅜, 1 required
X Molding, top of base (mitered), ½ by 1 by 10⅛, 2 required
Y Legs of base (square or turned), 2¼ by 2¼ by 27⅛, 4 required
Z End rails (13 in. between shoulders of tenons or 13 in. long if doweled), ⅞ by 6 by 14¼, 2 required
AA Back rail (22 in. between shoulders of tenons, or 22 in. long, if doweled), ⅞ by 6 by 23¼, whitewood, 1 required
BB Drawer front, ⅞ by 6 by 22, 1 required
CC Drawer ends or sides, ½ by 5 by 15½, whitewood, 2 required
DD Drawer back, ¼ by 4½ by 21½, whitewood, 1 required
EE Drawer bottom, ¼ by 15¼ by 21½, 3-ply, 1 required

(*Continued on page 124*)



EARLY AMERICAN WRITING-DESK

In Mahogany and Walnut. The design is based on an Early American Desk of Sheraton Influence, made of Mahogany and Satinwood, in the Metropolitan Museum of Art, New York

How to Finish Furniture —New and Old

JOHNSON'S WOOD DYE

(*Penetrating*)

If you have a hobby for making chests, cabinets, furniture, porch swings, radio boxes, etc., you will find our book on Wood Finishing invaluable. For, naturally, you want to give your handiwork a beautiful finish.

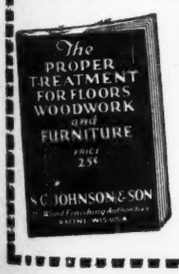
Our Book gives complete instructions for finishing new and refinishing old wood—soft or hard. It tells how to stain wood artistically—how to remove old paint and varnish—how to secure a beautiful enamel finish.

Johnson's Wood Dye is for the artistic coloring of all wood. It is very easy to apply—dries in four hours and will not rub off or smudge—penetrates deeply, bringing out the beauty of the grain. Made in 17 beautiful shades, among the most popular of which are:

123—Dark Oak	*131—Walnut*
129—Dark Mahogany	*126—Light Oak*
127—Brown Mahogany	*124—Golden Oak*

Order Johnson's Wood Dye from your dealer by name and number.

FREE—25c BOOK ON WOOD FINISHING



Ask for a **FREE** copy of the Johnson Book at stores displaying the sign shown at right. These stores carry Johnson's Artistic Wood Finishes and will be glad to show you wood panels—and answer questions on how to properly finish wood. If no store in your locality can supply the Johnson Book—mail this coupon for a copy Free and Postpaid.

YOUR DEALER'S NAME.....

Your Name.....

Your Address.....

City and State.....

Mail to: **S. C. JOHNSON & SON, Dept. PS3, RACINE, WIS.**
"The Wood Finishing Authorities" (*Canadian Factory: Brantford*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Linen Cabinet Made from Boxes

By Emanuel E. Ericson
Noted Manual Training Authority

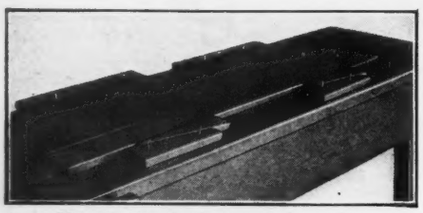
THE need for an inexpensive linen cabinet resulted in the unusually simple and satisfactory construction illustrated. Shelves with a 3-in. edge piece on the front are used instead of drawers. This not only cuts down the work of building the cabinet, but saves the housewife from having to open and shut heavy drawers.

All the lumber, except the pieces for doors, which are ½-in. thick white pine, and the back, which is wallboard, can be obtained from packing boxes.

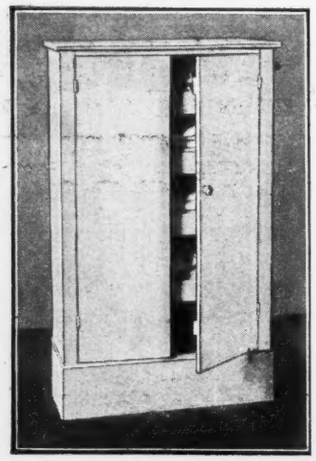
Much useful lumber can be obtained from boxes if care is taken not to split the boards. If the boards are longer than will be required, the best way to get them loose is to saw them off close to the ends of the box, leaving the nails undisturbed. If a nail-puller is available, it can be used effectively in saving the whole boards without splitting them; a hammer will serve, however, if careful work is done.

The top is glued together from two boards with a matched joint found on a box, the clamping being done with wedges as shown. The two facings to which the hinges are attached are nailed and glued.

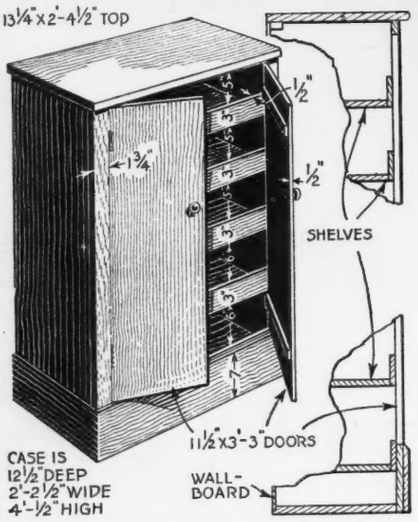
The cross pieces on the inside of the doors are fastened with flat-head screws,



How the top is glued and clamped together with wooden blocks and wedges



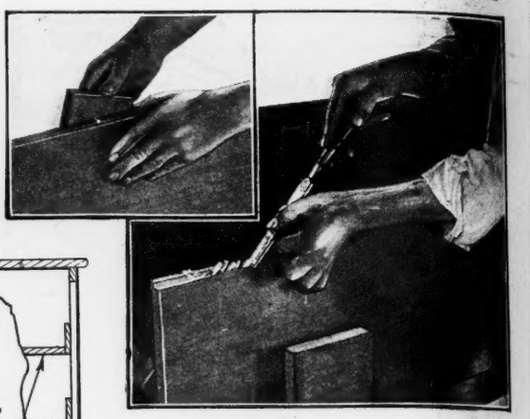
The finished cabinet (at left); using screw in block as marking gage, and chiseling a rabbet (below)



The general dimensions and construction of the case and sectional details of the shelving

the holes for which are enlarged slightly to allow for contraction of the lumber without cracking. No glue is used. Very little change in these boards will take place, however, if paint is applied on both sides, provided the lumber is reasonably dry. The recess or rabbet for the back is cut out with a chisel.

Before the case is nailed together, all the pieces must be planed and sandpapered thoroughly. The top is attached with eightpenny finishing nails and the shelves are nailed in through the sides of the case.

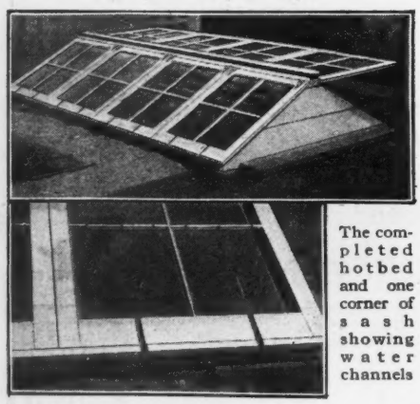


The hardware consists of two pairs of small steel butt hinges, one small elbow cupboard catch for the inside of the left door, a spring ball and socket catch of the type used on phonograph doors, and a glass knob, all bought at a 10-cent store for 30 cents.

One can each of white paint and enamel, costing 20 cents, with a spoonful of putty, suffices for the finishing. After the priming coat, all nail holes and crevices are puttied, some sandpapering done, and another coat of paint and one coat of enamel given.

Neat and Durable Hotbed Costs $24 to Construct

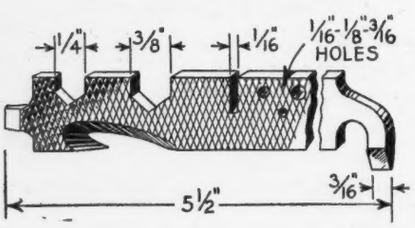
IF YOU are planning to build a small hotbed—and a hotbed is an invaluable adjunct to any garden—a good model to copy is the one illustrated. It cost $24 for materials, but will last at least 10 years. It is about 8 ft. long and 4 ft. wide, with hinged sash. The pit, which is walled up with concrete, extends 2 ft. or a trifle more into the ground.



The completed hotbed and one corner of sash showing water channels

The main frame is bolted to the concrete foundation. The ridge is a 2 by 4 in. piece, set flat and planed to fit the sloping edges of the sash. Note the grooves in each sash; they permit water to drain from the glass.—DALE R. VAN HORN, Walton, Neb.

Radio Tool for Many Uses Made from Old File

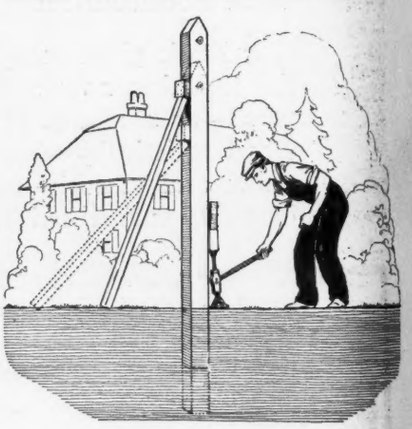


ONE radio fan who takes pride in being able to make emergency repairs to almost any kind of a receiving set, carries with him a tool made as illustrated from an old flat file.

The file was heated bright red and allowed to cool. It was then sawed, filed, and drilled and bent at one end as indicated above, and retempered.—G. L.

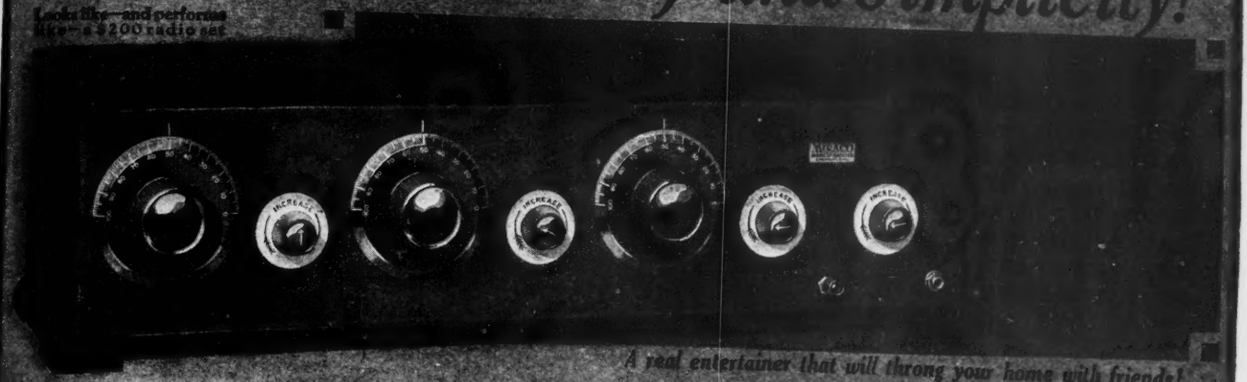
Jack Saves Labor in Raising Posts from Ground

FINDING it necessary to remove two 4 by 4 in. clothesline poles, I raised them from the ground by using an automobile jack, as shown. Blocks were nailed on to take the pressure of the jack and of the brace in the rear that prevented the post from tipping backward. It took about five minutes to lift each post.



Combines distance, selectivity, power, deep full tone, beauty and simplicity!

Looks like—and performs like—a $200 radio set



A real entertainer that will throng your home with friends!

The Marvelous MIRACO Model 5

—costs only $75

Send Coupon for SPECIAL OFFER

[FIVE TUBE OUTFIT IN BEAUTIFUL SOLID MAHOGANY CASE]

Completely built, thoroughly tested and factory guaranteed by one of America's oldest and most reliable manufacturers of quality sets! Years of experience and quantity production explain its almost incredible price. Users, who have deluged us with commendations, say that friends who see and hear it are amazed that it sells for less than $150 or $200. Radio experts, who know good construction and quality parts, are equally astonished. You, too, will be delighted, thrilled, amazed with your big five-tube Miraco "Ultra 5" in its beautiful hand-rubbed solid mahogany cabinet! You'll be envied by radio friends who paid big prices for their outfits. Imagine getting all this for $75—a beautiful sweet toned "coast to coast loud speaker" set, composed of finest parts, housed in solid mahogany, equipped with the latest improvements, refinements and features found on costliest sets—and factory guaranteed! An instrument approved by radio's highest authorities! A set anyone can connect and operate. Even beginners learn quickly to cut through the "locals," get distant stations loud and clear, log stations and return to them at will. (Full directions with each set.) It is non-radiating, non-distorting, non-howling. Has cut-out switch—and a first stage phone jack for tuning—on Bakelite panel. All wiring concealed under Bakelite sub-base. Works on storage battery or dry cells. Literature describes other newest features.

"Coast to Coast" reception verified by Miraco Users

NOTE! Do not judge Miraco sets by their prices. Enormous production makes them cost less. They are built by pioneer set makers—of highest grade parts. They embody improvements, refinements and features used in the most costly sets. Every Miraco user is an enthusiastic booster—these letters are typical of the many we receive.

MARYLAND HEARS EUROPE
During International Radio Week I received European stations several times upon my Miraco. Who wouldn't be satisfied with results like this?—Jos. E. Cook, Owings Mills, Md.

CALIFORNIA HEARS EAST COAST
Miraco works fine. Last night I got Cuba on loud speaker, I also pick up East Coast programs in spite of local interference. — Clinton Elliott, Long Beach, California.

ILLINOIS HEARS LONDON
Miraco operates wonderfully. Thursday night I heard the program from the Hotel Savoy, London, for about 35 minutes.—Carl Mackey, White Heath, Ill.

BERMUDA HEARS CALIFORNIA
On my Miraco I have received KGO at Oakland, Cal., a distance of over 3,000 miles four times in last four weeks. Also have received five stations about 2,000 miles away and about twenty over 1,000 miles away.—L. O. La Spurling, Spanish Pt., Bermuda.

NEVADA HEARS CUBA
Am able to get all Eastern Coast stations with my Miraco as well as Havana, Cuba and Mexico City. Also all Canadian stations. Had Havana loud enough to broadcast same over telephone a distance of 300 miles.—A. A. Ewing, Rox, Nevada.

VERMONT HEARS MEXICO
I have received stations as far as Mexico City, Mexico, Calgary, Canada, Cuba and Texas on my Miraco.—A. V. Little, Vergennes, Vt.

MASS. HEARS BELGIUM
Nov. 27th at 11.25 P. M. I heard 2LO London, England, on the Miraco. Nov. 30th at 11.40 P. M. heard SBR, Brussels, Belgium. You can't get a better set for the money.—M. J. Diacoe, Pittsfield, Mass.

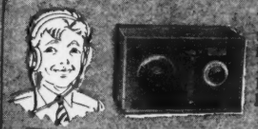
N. Y. MINISTER HEARS EUROPE
I tuned in four different European stations last week on my Miraco. My guests and I heard 2NO Newcastle, England, very clearly—a piano solo from Rigoletto. Also heard voice, in Italian announce 1RO, Rome, Italy. Concerts from other stations came through but static crushed at their conclusions—one was in Flemish.—Rev. Thos. E. Owen, St. Patrick's Rectory, Rossiv, N. Y.

PENNSYLVANIA HEARS CALIF.
Have listened to Cuba, California and possibly 100 other stations. All who hear Miraco proclaim it the best they have ever heard.—C. H. Stevens, Altoona, Pa.

MISSISSIPPI HEARS HAWAII
Installed the Miraco myself and I had never had any experience with radio at all. Have gotten Havana, Cuba and Honolulu.—H. Kittle, Shaw, Miss.

NEBRASKA HEARS CUBA
Miraco is a wizard. I have handled radios for two years—have not seen its equal under $200. Heard Havana, Cuba, Saturday night despite that their language is hard to discern on a radio.—C. G. Stockman, Synder, Neb.

Other Miraco Long Distance Sets $14.35 up



Users tell us that Miraco Model K justly deserves its title, "Radio's finest low priced quality receiver." One tube acts as a tuned radio frequency amplifier and detector combined. A great distance getter. Easy to operate and log. Covers all wave lengths 150 to 625 meters. Like all Miraco sets, it operates on a storage battery or dry cells. Never such value before at only $14.35 report delighted users.

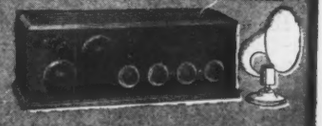
MIRACO RADIO GETS 'EM COAST to COAST

This wonderful new Miraco Model R-3 is the three-tube, long distance, loud speaker set that has created such a sensation. Easy to tune and log. Covers wave lengths 150 to 625 meters. Detector sets also as a tuned radio frequency amplifier, 2 stages audio frequency amplification. Unsurpassed for simplicity, volume, range or clearness at anywhere near its price.

Miraco R-3 only $29.60

These Miraco sets are as easy as a phonograph to operate. Built throughout of highest grade parts. Full directions for connecting and operating supplied with each set. No experience necessary. The three and four tube sets have cut-out switch and first stage phone jack. Each set completely built, thoroughly tested and factory guaranteed.

The famous Miraco Model MW four tube "coast to coast loud speaker" outfit which users all over the country report outperforms and outdistances much costlier sets. Comes in a solid mahogany cabinet. The improved 1925 model is equipped with cut-out switch, first stage phone jack for tuning (removing plug automatically switches program to loud speaker) and other latest features. Employs one stage of radio frequency amplification, detector and two stages of audio frequency amplification. Another unmatched Miraco value. $54.50.



All the Proof you want is waiting for You!

Reports from the many users in every state prove Miraco Tuned Radio Frequency Receivers—at rock bottom prices—have efficiency of sets costing up to three times as much. Remember that Miraco Sets are the product of a long established, reputable manufacturer—pioneer builders of sets. Send for further evidence that Radio offers no finer moderately priced receivers. All Miraco sets bear the endorsement of radio's highest authorities. Mail coupon now for latest bulletins and plenty of additional testimony from users leaving no doubt that "Miraco Radio Gets 'em Coast to Coast."

Send coupon for free bulletins or order direct from this ad

MIDWEST RADIO CORPORATION Ⓘ
Pioneer Builders of Sets
408-W East Eighth Street **Cincinnati, Ohio**

Send free literature, your special offer, and all particulars regarding Miraco Sets. ☐ Jobber. ☐ Dealer. ☐ Agent. ☐ User.

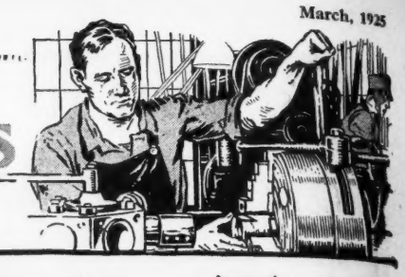
Name .....

Address .....

Ⓘ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Better Shop Methods

How Expert Mechanics Save Time and Labor



Winning a Shop Race against Time

Old Bill Bores a 7-Foot Pulley on a 20-Inch Drill Press

James Ellis

By James Ellis
Machine-Shop Superintendent

A FEW minutes before time for Old Bill and his boys to begin work, a mud-covered truck rattled and coughed up to the door of the shop. Several sleepy-looking men were on it, and one or two who did not seem so tired. The truck was hot, and had all the signs of having made a long trip in a hurry.

The human cargo unloaded and brought to light a big, rusty pulley that looked as though it had been rescued from the scrap heap.

The shop men coming to work stopped and looked. One asked what was to be done. The man in charge replied that he wanted the hole bored out to fit a 4 7/16-in. shaft.

"We broke a pulley this size on the main lineshaft last night," he explained, "and happened to find this one out in the yard, where it had been discarded a long time ago. It is just the thing, but the bore is too small. It is wider than the old pulley, but that will not matter."

The shop man gave one of those peculiar whistles that those who work about machinery use to indicate amazement.

"There isn't a machine in the shop that we can put this in at once," he said. "I suppose you want to get this right away?"

"You bet we do!" the mill man returned. "The boys and I," he waved toward his companions, "have spent most of the night getting this pulley out of the yard and bringing it here. Until we get this, the whole plant will have to stay shut down, and most of the men will be laid off. We are behind on a contract, and I hate to think of what will happen if we lose much time!"

OLD Bill came along about this time and surveyed the truck, the men, and the wheel. He recognized the speaker as Jack Hayes, engineer at the Johnson Mill Company.

"Well, Jack, old scout, what sort of trouble are you bringing me this time?" was Old Bill's greeting.

"Bad trouble!" the mill man replied, "and you have *got* to help me out!"

"All right; that's what we are here for," Old Bill said with a smile. "What do you want done?"

"This pulley that we have dug out of the scrap pile is just the size of one that broke on the main lineshaft last night, except that the hole is too small. Your job is to bore it out, and do it in a hurry!"

"Looks to be about seven feet," Old Bill said, half to himself. "Too big for the boring mill—Well, maybe we could raise the big lathe."

"Imagine what a place this would be if we got too excited about these rush repair jobs," said Old Bill to the mill-owner's son

"That long shaft is in the big lathe," Bob Laton, one of the machinists, reminded him.

"That's so. Then I guess we'll have to do something else with it."

The work whistle was blowing. The men started in to their machines. Old Bill spoke to one of them, who called to several others to help him roll the pulley into the shop.

Old Bill went on with his accustomed routine, going from one machine to the other to see how his men were progressing. Hayes became impatient and explained again the necessity of getting the job done at once.

"I have brought a lot of men with me to help you if you can use them," the mill man continued. "I have the big boss's son along also. The Old Man thought that he might like the trip, or something. I suppose he expected him to speed you up; at least, that is what he said!"

"Well, we'll get you out all right," Old Bill promised. "You fellows had better run off and get some breakfast. I will attend to the job." They did as Old Bill suggested. When they came back, they were surprised to find the pulley still standing where it was.

Young Johnson came up to Old Bill.

"Don't say it!" Old Bill cautioned. "I know that you are going to tell me that this is the most important thing in the shop, and that I ought to think about nothing else!"

The young man looked sheepish, for that was exactly what was on the tip of his tongue.

"It may seem that I have not given your job a thought; but I have," Old Bill continued. "I think you heard the boys say that there was not a machine in the shop that would swing this wheel."

Johnson nodded assent.

"Well, I have found a way to do it, and before long you will see something happen."

Bob Laton was coming over to Old Bill with a few tools in his hand.

"I have got the new man started on the job that I was doing," he said, "and as soon as I put away these tools, I will get the pulley over to the drill press."

"We shall have to do it on the 20-inch drill," Old Bill said. "I forgot that I had a lot of drilling to be done on the radial when I told you to put the wheel there."

Laton looked puzzled.

"On the 20-inch drill?" he questioned. He looked over to where the wheel was, as if to make sure that it was as large as he thought. Then he burst out, "Oh, I see! I'll get right on it!"

And he did. Young Johnson followed him to the job. Laton may have seen, but Johnson did not see at all.

"HOW in the world are you going to get that big pulley into this little machine?" he asked.

Laton replied with a laugh.

"Easy," he said. "This pulley of yours is split, so we will take it apart and put it together around the machine!"

It was not long before the pulley had been put together again around the column of the drill press. Its rim was blocked up from the floor. Laton went to the toolroom, bringing back a boring bar, which he fitted into the spindle of the

(*Continued on page 150*)

DON'T fail to turn to pages 144-158, where you will find the continuation of the Better Shop Methods Department.

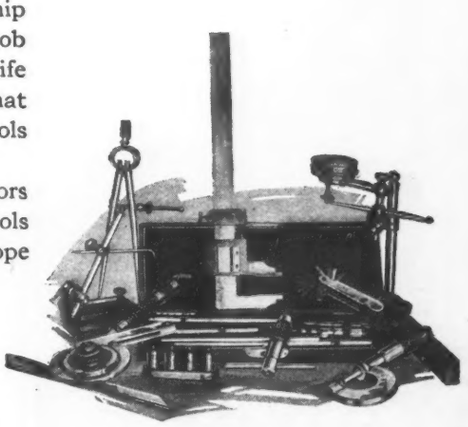
Why do the Toolmakers work with Starrett Tools

Starrett

The Choice of Two Generations

Back of your Starrett Tools is the satisfaction of two generations of crack machinists. Find the best mechanic in any shop and invariably you will find a Starrett booster. His work calls for the closest fits, the closest limits, the closest measurements. The Precision Tools it takes to do the job, ***he's got***. Naturally, his choice is Starrett. Accuracy, of course, but more than that. Design that means easy, rapid work. Workmanship that keeps a Starrett on the job years beyond the serviceable life of other tools. Confidence that comes through working with Tools he's always found reliable.

Toolmakers, Foremen, Inspectors —they're not using Starrett Tools for the fun of it. The pay envelope tells the story.



THE L. S. STARRETT CO.

World's Greatest Toolmakers
Manufacturers of Hacksaws Unexcelled
ATHOL, MASS.

7442

In this group of Starrett Tools are the Improved Universal Bevel Protractor No. 359 (with Fine Adjustment), Toolmaker's Dividers No. 277, Inside Micrometers No. 124, Automatic Adjustable Stroke Center Punch No. 18, T-Handle Tap Wrench No. 93, and Toolmaker's Universal Surface Gage No. 56. All completely described in the Starrett Catalog of 2200 Fine Precision Tools. Write for No. 23 "W".

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Drilling out cylinder head bolt close to cowl—an awkward job made easy by "Yankee" Double Ratchet.

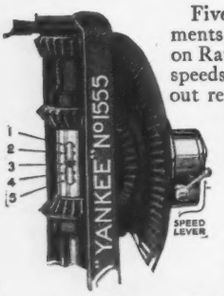
Tight against the cowl yet he drills easily

He doesn't need space to revolve crank of "Yankee" Ratchet Breast Drill.

When set on DOUBLE Ratchet any slight movement of crank back and forth causes drill to cut continuously.

By doing the otherwise impossible jobs, a "Yankee" Ratchet Breast Drill saves the time and expense of taking down construction.

"YANKEE" Ratchet Breast Drill No. 1555



Five ratchet adjustments changed by touch on Ratchet shifter. Two speeds, changed without removing drill from work. 3-jaw chuck holds round shank drills up to ½ in.

No. 555. 2-jaw chuck holds both rounds and squares up to ½ in.

Five Ratchet Adjustments
1. Plain Drill
2. Left-hand Ratchet
3. Right-hand Ratchet
4. DOUBLE Ratchet
5. Gears Locked

Dealers Everywhere Sell "YANKEE" TOOLS

"Yankee" on the tool you buy means the utmost in quality, efficiency and durability.

Write for FREE Tool Book

NORTH BROS. MFG. CO., Philadelphia, U.S.A.

"YANKEE" TOOLS

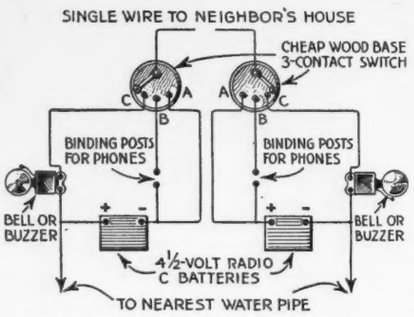
Make Better Mechanics

The Home Workshop

How to Rig a Simple Phone Line to Your Neighbor's House

DO YOU have occasion to call your neighbor on the phone quite often? Possibly your most intimate friend lives only a few hundred feet away and you use up a lot of phone calls talking to him. If this is the case, you can rig up a simple telephone line between your houses that will permit you to talk with him as much as you want without expense for phone calls and, furthermore, no one can listen in on your conversation.

Look over the accompanying wiring diagram. Assuming that you are both radio enthusiasts and are possessed of a pair of head phones apiece, the only additional apparatus you need will be two ordinary switches, each with three contact points, a couple of house bells or buzzers, two of the C batteries sold for radio use, and a length of single wire sufficient to reach from your house to his. If no head phones are available, buy one cheap pair and use one unit at each end.



Wiring diagram, showing how the batteries, bells, switches, and phones are hooked up

The arrangement of the wiring is such that you can call your friend or he can call you at any time, yet there will be no current flowing in the wire when the line is not in use.

Each switch should be left with its lever on contact *C*. If either switch is moved to contact *A*, the bell at the other end of the line will ring. After the person at one end of the line has made a call in this way, he moves his switch to point *B* and talks into one of the head phones while he listens with the other. The party receiving the call also moves his switch to point *B* and proceeds to talk in the same fashion.

When one unit is used at each end of the line, both the talking and listening are done with it.

Be sure to connect the batteries as shown, for if you get one of them reversed, they will oppose each other and no current will flow through the phones when the switches are on points *B* and *B*.

In the Workshop Schedule

COMING Home Workshop features are: "Re-Upholstering Chairs," "A Wallboard Screen," "A Toy Passenger Air Coach," "Methods of Adding Speed to a Speedster," "A Child's 'Motorcycle' with Sidecar," "What Makes My Ford Creep," and "Repairing a Porch Column."

!! Still Time to Compete for the $50 in Prizes Offered for Handicraft Photos !!

AS THIS issue of POPULAR SCIENCE MONTHLY goes on the newsstands about February 10, you may still have time to enter the contest for handicraft photos announced last month.

A First Prize of $25
A Second Prize of $15
A Third Prize of $10

are offered for the best photographs of the more uncommon and ingenious handiwork of amateur craftsmen.

Perhaps you have built a strikingly original piece of furniture, a model, a toy, sporting equipment, scientific apparatus, or some sort of household utility. If so, photograph the piece, write a description of not more than 200 words telling what it is and how you came to make it, and send it to POPULAR SCIENCE MONTHLY, 250 Fourth Ave., New York. Mark the envelope "Handicraft Photo Contest."

In many instances it many be advisable to submit two photos, one an attractive picture showing the object in use and the other giving a close-up of its construction.

Photographs that do not win prizes, yet are available for publication, will be purchased at regular rates.

All photographs must be received on or before February 24. The Board of Editors of POPULAR SCIENCE MONTHLY will act as judges and their decision will be final. Unavailable photographs will be sent back only when accompanied by a self-addressed label bearing return postage. The winners will be announced as soon as possible after the judges complete their task.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Ready with your Kodak

There's a real thrill to the picture that breaks on the scene without warning. Out comes your Kodak; quickly and easily you bring it into play and—the picture that found you prepared, soon finds a place in your album.

Autographic Kodaks $6.50 up

Eastman Kodak Company, Rochester, N.Y., *The Kodak City*

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

What Makes the Wheels Go?

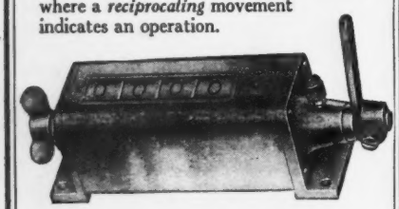
From the boyhood experiment with the family clock to the full-grown problems of machine development—the question holds.

Motors supply mechanical energy, while Veeder Counters supply *human* energy to make machines beat their own best records for output.

On the dial of a counter your machine indicates "what makes it go." What *mechanical* features or operating methods make it go *BETTER*, as shown on the

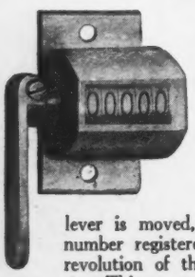
Veeder COUNTER

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-back *Revolution* Counter of similar model, $10.00 (*list*).

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



Whatever you need in a counting device is shown in the 80-page Veeder booklet. Your request brings it promptly.

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

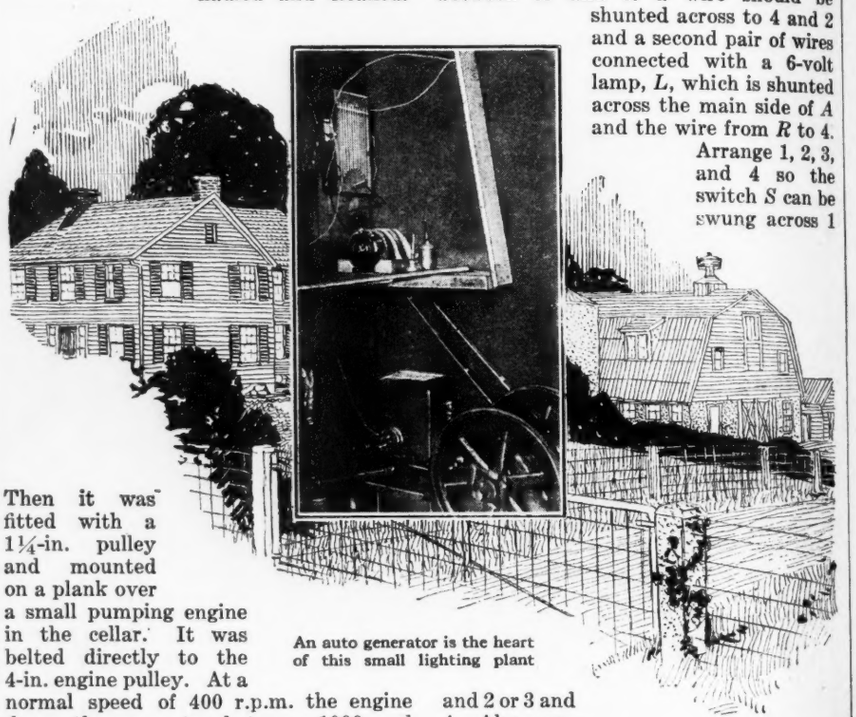
The Home Workshop

A Vest-Pocket Lighting Plant

By Lawrence B. Robbins

FARM lighting plants cost money, even the least expensive, but for a few dollars any rural dweller can rig up a low-voltage plant that will give light at little expense. The one illustrated is composed of an automobile 6-8-volt generator and two storage batteries. The generator was charged to profit and loss on a wrecked car, as was one battery. Another battery was later added to give longer service on a single charging.

The generator was thoroughly overhauled and cleaned. Then it was fitted with a 1¼-in. pulley and mounted on a plank over a small pumping engine in the cellar. It was belted directly to the 4-in. engine pulley. At a normal speed of 400 r.p.m. the engine drove the generator between 1000 and 1200 revolutions—sufficient to generate eight volts.



An auto generator is the heart of this small lighting plant

The wiring diagram shows how this plant was hooked up, using a homemade rheostat and a circuit-changing switch.

The rheostat was made by tacking a sheet of ½-in. asbestos to a board and screwing both to the wall. Ten brass tacks were nailed along the top in a line and 10 more in an arc below them. Then No. 20 German-silver wire was stretched back and forth from one tack to the next, as indicated.

A brass switch lever was pivoted in the center of the rheostat at the bottom so that it would touch the tacks throughout the arc.

The circuit-changing switch was cut from stiff sheet brass about 5 in. long after the pattern shown.

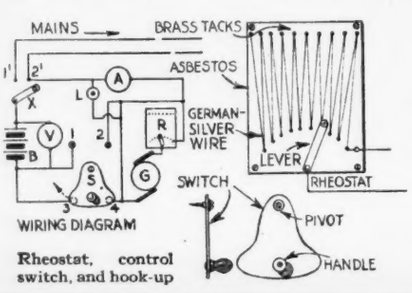
The explanation of the wiring diagram is as follows: One terminal of the generator, *G*, is connected with the lever of the rheostat, *R*. The other terminal of *G* goes to switch point 4. Point 3 then goes directly to battery *B*. The voltmeter *V* is shunted across the battery terminals. Switch point 1 also is connected with the wire from 3. The opposite *B* terminal connects by switch *X* to both main wire terminals, Nos. 1^1 and 2^1.

The other *R* terminal (from end of resistance wire) goes directly to the ammeter, *A*, and then to 2^1. From a point between *A* and *R* a wire should be shunted across to 4 and 2 and a second pair of wires connected with a 6-volt lamp, *L*, which is shunted across the main side of *A* and the wire from *R* to 4. Arrange 1, 2, 3, and 4 so the switch *S* can be swung across 1 and 2 or 3 and 4. Also connect the positive terminal of *G* with the positive terminal of *B*.

To charge, swing *S* down across 3 and 4, start engine, and then swing switch *X* over to 2^1. This allows charging current to go through *R*, where the voltage is regulated in case the speed of engine becomes excessive, as indicated by the reading of the voltmeter. From *R* it goes through *A* to *B* and back again through 3 and 4 to *G*. Figure *L* lights to aid the operator in watching operations and also acts as a pilot light.

When the charging is done, shut off the engine, swing *X* to 1, and *S* up to 1 and 2. This leads the battery current directly to main wires and cuts out the generator. The house wiring must be done with wire not smaller than No. 12.

In this particular system the owner uses regulation auto-headlight sockets



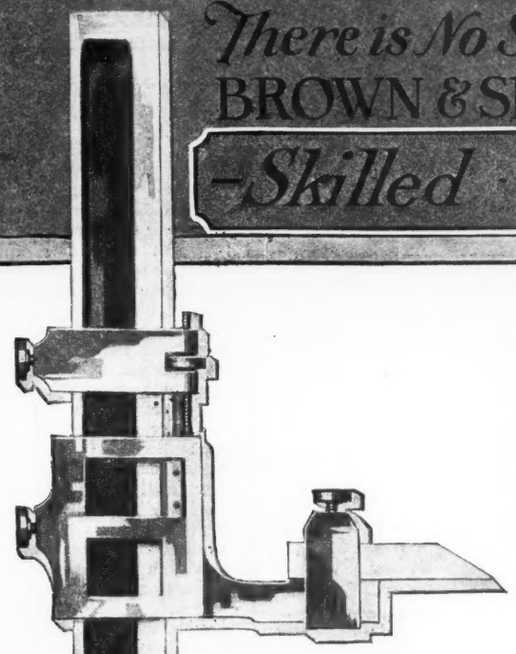
Rheostat, control switch, and hook-up

(*Continued on page 124*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

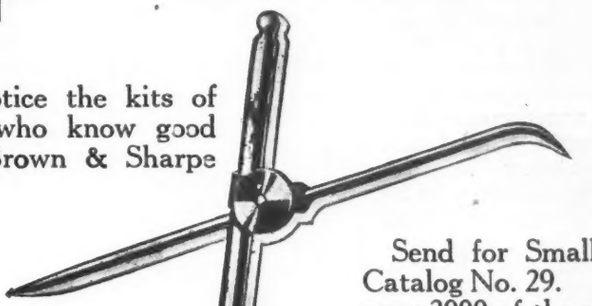
One More Reason Why

There is No Substitute For
BROWN & SHARPE *Quality*
-Skilled Workmanship-



Because of skilled workmanship every Brown & Sharpe Tool is sure to satisfy its owner. Made with modern equipment in the largest factory of its kind in America by experienced workmen, it is destined for a long life of precision and service. Skilled workmanship is only one more feature of the excellence of Brown & Sharpe Tools—an excellence which makes them good tools to own.

You'll notice the kits of mechanics who know good tools are Brown & Sharpe equipped.



Send for Small Tool Catalog No. 29. It lists over 2000 of the world's finest tools.

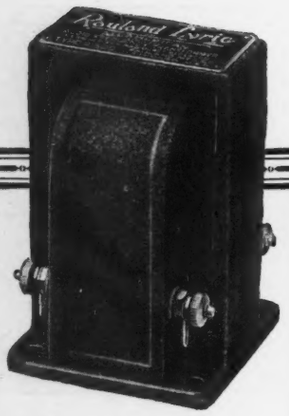
Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.

IS

BROWN & SHARPE TOOLS

"Standard of the Mechanical World"

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



Tonal Beauty Lies Deeper than the Varnish

DEEPER even than the circuit diagram—chiefly, indeed, in the *audio transformer.*

All-American engineers, builders for years of the *largest selling transformers in the world,* have achieved another triumph, in a new type of transformer which has proven a revelation to music lovers. *Rauland-Lyric amplification,* with an ordinary tuner and loud speaker, has received the plaudits of musical authorities hitherto skeptical of all radio reproduction.

Perfect amplification makes of radio a joy unending. Who shall say that such a benefit is not worth the slight additional cost?

There is romance in the story of Rauland-Lyric. A request will bring it to you complete—from the original laboratory studies to the auditions with world-famous music critics. Rauland Manufacturing Company, 2668 Coyne St., Chicago.

Price $9.00
Ask Your Dealer

Rauland-Lyric
AN ALL-AMERICAN TRADE MARK TRANSFORMER
The Choice of the Noted Music Critics

The Home Workshop

Spirals Ornament Graceful Stand

By William J. Edmonds, Jr.

THE stand illustrated below incorporates spiral turnings made by hand according to instructions given in the article, "Making a 'Turned' Spiral Pedestal," in the April, 1924, issue of POPULAR SCIENCE MONTHLY.

Unique stand with spirally turned legs

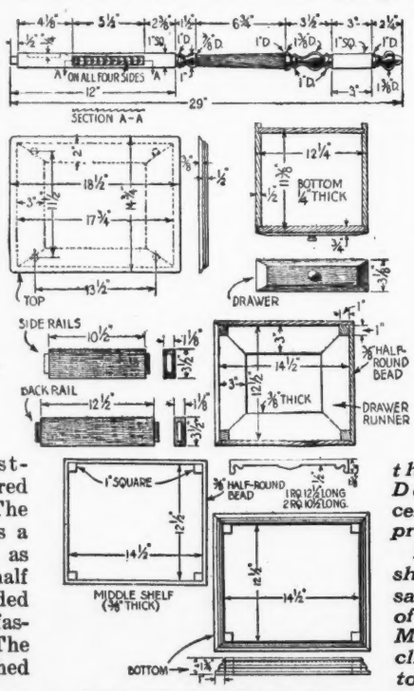
There is nothing particularly difficult either about this or any other part of the stand, and if sufficient care is taken with the small details the completed piece is a desirable addition to the furniture of any home. Any good cabinet wood may be used; in this case oak was chosen.

The four legs first are turned in the lathe. The spirals are cut by hand, as described in the article just mentioned, except that the circumference, instead of being divided into four equal parts to give a four-strand section, is laid off into 13 equal parts to give 13 strands. Instead of using a backsaw for cutting the depth of the strands, a parting chisel was used, but the other operations were the same.

In the upper end of two of the legs, a single mortise is cut to accommodate the corresponding tenon of the side rail. In the other two legs two mortises are cut into adjacent sides to take the tenons of the side rails and the back rail.

THE top is fastened to a mitered frame, as indicated. The drawer runner also is a frame. It is made as shown and a 3/16-in. half round bead is added after the runner is fastened to the leg. The middle shelf is finished with a similar bead.

The ornamental pieces below the middle shelf are identical, except that the front one (and back one, if used) is 12½ in. long and the two side pieces are each 10½ in.



Working details of the leg turnings, top, framework and drawer

Have You Joined the Order of Home Craftsmen?

AN ASTONISHING range of craftsmanship is shown in photographs sent to the Home Workshop Editor by readers of POPULAR SCIENCE MONTHLY.

Some of the pictures illustrate articles made by men who have had no training in woodworking. Certain Home Workshop designs caught their fancy and, gathering together whatever tools they could find about the house, they made the articles with a success that surprised themselves and their families.

Other photographs show the work of skilled craftsmen, who, with the keen judgment of experience, look constantly to the Home Workshop for new ideas. A striking example of this type is the stand illustrated and described on this page.

If you are not sharing in the great enjoyment that readers of the Home Workshop get from their work at the bench, why not start to make something yourself, no matter how simple? You will find, like all the others who have taken up this hobby, that enthusiasm in home craftsmanship, once aroused, is quite irresistible.

The bottom proper without the molding is composed of two pieces glued together, one ¼ in. thick, of the same wood as the stand, and the other, of 1½-in.-thick pine. An appropriate stock molding is mitered around the bottom after assembling. The parts are put together with good glue, screws and small brads. Either a wax or a varnish finish may be used, as preferred.

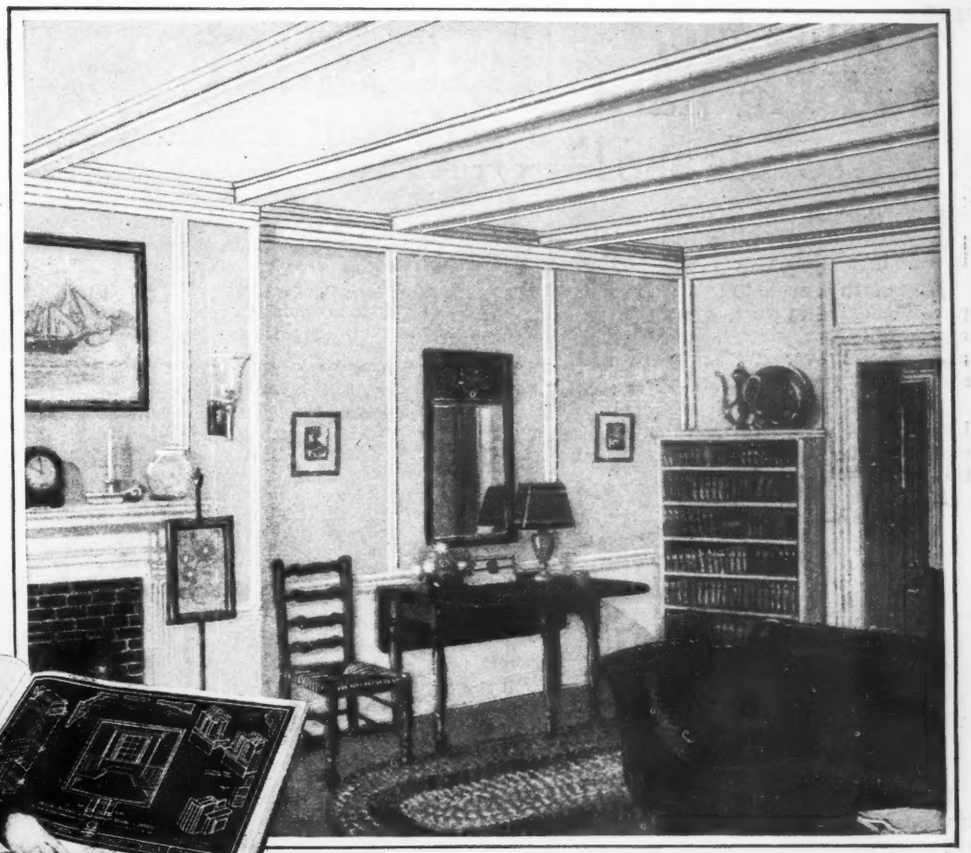
IF YOU missed the article on hand-made spiral turnings referred to by Mr. Edmonds, you can obtain a copy of the April, 1924, issue of POPULAR SCIENCE MONTHLY from the Circulation Department for 40 cents, the regular price for back copies.

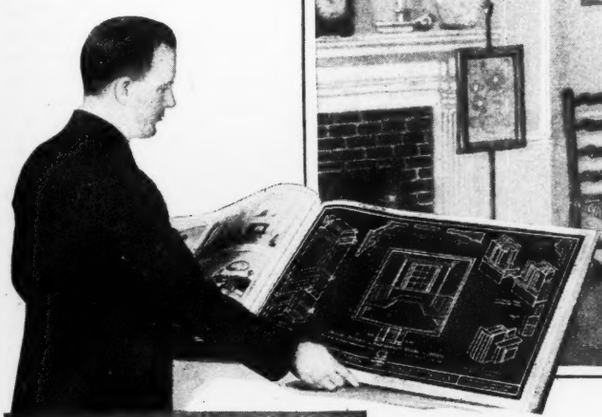
Every home worker should make a point of saving his back copies of POPULAR SCIENCE MONTHLY, or at least clippings of the articles to which he may wish to refer at some later date. The back copies of the magazine are rapidly becoming exhausted and some issues cannot be obtained at all.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

The Board of 100 uses

Aside from its use for walls and ceilings, Upson Board has 100 uses around the home. Its easy workability makes it ideal for making wardrobes, photographic dark rooms, cabinets, doll houses, wastebaskets, lapboards, tables, toys and countless other useful articles. You should have at least a half dozen panels in your home workshop all the time.





Impartial tests prove Upson Board superior!

Harder, Stronger, Stiffer!

Here is a remarkable test that proves the greater strength of Upson Board as compared with plaster or gypsum-filled boards. Over 1000 pounds sustained by a single panel of Upson Board! Gypsum-filled board broke with less than one-third the weight. Upson Board is not brittle—it cannot crack or fall!

More water-resisting!

In another very conclusive laboratory test, Upson Board immersed in water for a given length of time gained only ½ ounce to the square foot. Gypsum-filled board exposed to the same test increased nearly ½ pound to the square foot. Other wallboards tested in the same way were found to absorb nearly twice as much water as Upson Board.

The wonderful new Upson Blue Book

the first complete service to help you renew and beautify walls and ceilings

THE new Upson Blue Book—already in the hands of most Upson dealers—brings to "Popular Science" readers the most amazingly complete plan service for permanently renewing and beautifying walls and ceilings.

Forty "detail plans"—designed by several of America's leading architects—show you how to achieve the much-desired beauty of tasteful interior paneling. A host of suggestions for decoration and trim help you to finish each room in the most appropriate design. Pages of pictures show possibilities in furnishings.

Whether you are repairing or building new—you will want the inspiration, new help, of this wonderful new Upson Blue Print Service. And you will want to know more, too, of the distinctive beauty of properly paneled Upsonized rooms.

Ask your lumber dealer to show you this wonderful new Upson Blue Book. If he hasn't it, send us his name and 25c, and we will send you full-size, detail blue print with complete instructions for Upsonizing any room. (State kind of room and whether new work or remodeling.)

THE UPSON COMPANY
327 Upson Point Lockport, N. Y.

UPSON BOARD

PROCESSED

BLUE CENTER

THE UPSON COMPANY
327 Upson Point, Lockport, N. Y.
Enclosed find 5c for samples of Upson Board and Upson Fibre-Tile, together with portfolio of Upsonized interiors.
Name.....
Address.....

Whenever you see or hear of color used as an identification of wallboard, think of dependable Upson Board with its famous Blue center

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

"It suits me, and I'm hard to please!"

Some smokers are apparently easy to please and easy to suit in their pipe tobacco. There are plenty of brands for them.

Edgeworth is made to suit the hard-to-please smoker—in fact, for those who might call themselves connoisseurs, if pipe-smokers ever did apply so high-sounding a term to themselves.

Mr. Burrow, while modestly regretting his avowed lack of equipment as a testimonial writer, speaks volumes in one trenchant sentence.

Here is his letter:

Larus & Brother Co.,
Richmond, Va.
Gentlemen:

Were I possessed of a gifted power of speech, a trenchant pen, and a Harvard vocabulary, I'd dash off to you a prosy sentiment extolling the virtues of Edgeworth. *However, it suits me—and I'm hard to please!*

This—after many unsatisfactory attempts to suit my sensitive palate. My records of purchase will bear me out that it satisfies me, and I'd go a long way for Edgeworth.

Very truly yours,
G. M. Burrow

Edgeworth in a way is similar to the kind of men you form decided opinions of—perhaps favorable, perhaps unfavorable. But the point is, the very character of such men forces you to a definite opinion, one way or the other.

Edgeworth is pretty much that kind of tobacco—smokers either like it immensely or not at all.

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality. Write your name and address to Larus & Brother Company, 10C South 21st Street, Richmond, Va.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

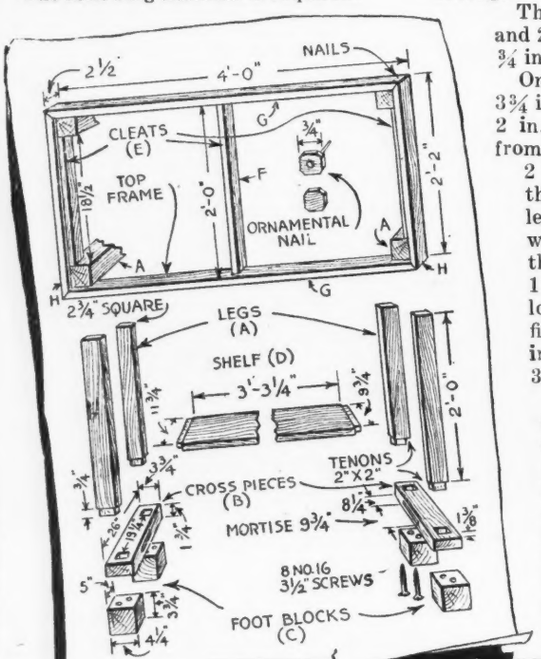
To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

The Home Workshop

Oak Hall Table Has "Leather" Top

YOU will encounter no difficulties in the construction of this simple hall or living-room table. A good saw, brace and bits, plane, hammer, nail-set, ½-in. chisel, sandpaper, file, and pocket-knife are the only tools needed.

The following material is required:



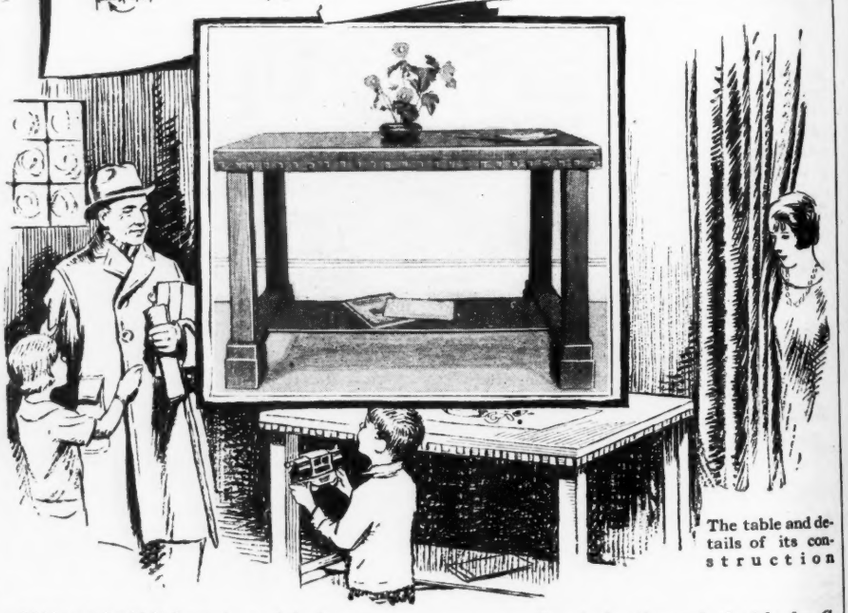
2¼ in. sq. by 10 ft. long, clear oak for legs, *A*
1¾ in. by 3¾ in. by 5 ft. oak for cross pieces, *B*
3¾ by 4¼ by 24 in. oak for foot-blocks, *C*
1 by 11¾ in. by 4 ft. oak for shelf, *D*
¼ by ¾ in. by 6 ft. oak for ornamental nail heads
1 by 2½ in. by 13 ft. poplar, gum, or soft pine for top frame members, *G* and *H*
1 by 1½ in. by 5½ ft. poplar, gum or soft pine for cleats, *E*, and cross piece, *F*
1 by 12 in. by 8 ft. poplar, gum, or soft pine for top
8 No. 16 screws 3½ in. long
No. 18 ¾-in. brads
Sixpenny finishing nails
Glue
Imitation leather 1 yd. wide, 5 ft. long

If you can have the wood dressed to size in the piece, it will cut the work in half. Sight along the pieces and true them up, if there are any "winds" or warped portions. Test them with your try-square and plane them before cutting to length.

The legs, *A*, are 2¾ in. square and 24¾ in. long, including a tenon ¾ in. long and 2 in. square.

On the cross pieces, *B*, which are 3¾ in. wide, 1¾ in. thick, and 2 ft. 2 in. long, measure back 1⅜ in. from the ends and cut four mortises 2 in. square and ⅞ in. deep for the corresponding tenons on the legs, *A*. Also cut mortises ½ in. wide and 9¾ in. long in *B* for the tenons on the shelf, *D*. *D* is 11¾ in. wide and 3 ft. 3¼ in. long, with 1-in. tenons added to fit the corresponding mortises in *B*. Blocks *C* are 4¼ in. wide, 3¾ in. thick, and 5 in. long.

After fitting the shoulders of the tenons on *A* to the mortises in *B* and testing with the square, lay the legs aside and bore two 3/16-in. holes in opposite corners of the mortises. Now lay *B* on the blocks *C* so that the latter project ½ in. beyond the former at the sides and ends. Mark through the holes with a pencil and bore corresponding holes through the blocks, *C*. Counterbore the holes from the bottom exactly 2 in. with a ½-in. bit. After marking and boring corresponding 3/16-in. holes in the tenons of the legs, you are ready to screw the 10 pieces firmly together.



The table and details of its construction

Apply glue to the tenons of the shelf, *D*, place it in position, drive it home, and tack it from the bottom with small nails.

The top frame may be built with square

(*Continued on page 122*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

TWO thoroughbreds! That's what they are—made for the craftsman that buys the best, when he adds a tool to his chest.

A V & B Vanadium hammer you'll want to buy. They are made from special V & B formula vanadium steel, and handled with the finest hand-shaved, second growth white hickory. Octagon necked, and round faced—with a special non-slip claw, that firmly grips either a brad or a spike. A Vaughan's Expansion Wedge firmly locks the handle tight—is positive insurance of a tight head.

You'll want, too, V & B Unbreakable Planes. They are drop forged—*not cast*—from a solid bar of V & B supersteel. Stand the falls that would break an ordinary plane. Furnished with all vanadium steel blades and walnut handles, in the sizes you will want.

Two tools of particular merit—get them for your kit!

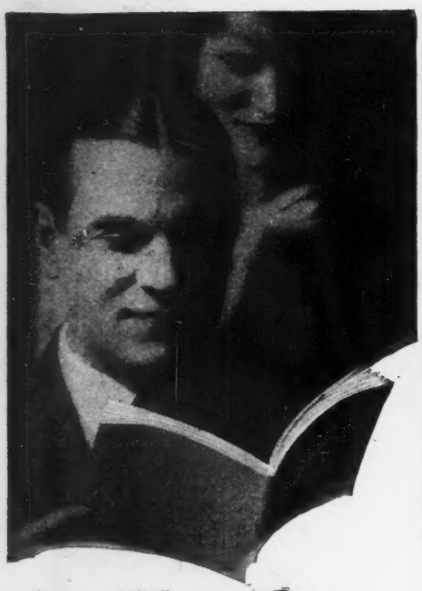
VAUGHAN & BUSHNELL MANUFACTURING COMPANY

Makers of Fine Tools

2114 Carroll Ave. Chicago, Ill. U.S.A.

Ask your hardware dealer to show you V & B Vanadium Hammers and Drop Forged Planes. If he carries fine tools he has them. They're the kind of tools fine craftsmen like, the kind it pays to buy.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



See How Soon You Can Start A Fortune

Make This Test

No matter how small your income now is, if you know how, you may become financially independent in a very few years. A valuable book—now free—will enable you to make the test which is showing hundreds of ambitious men the road to success.

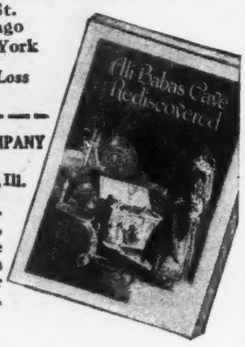
Here is a plan that will make it surprisingly easy for you to build up a comfortable sum—and in a comparatively short time.

For years large investors have known how to build up fortunes with absolute safety—through legitimate investing. And now anyone can accumulate a fortune in exactly the same way. The tested plans of experienced, successful investors are now available to the smaller investor. Through following their methods you can double your money in a little over ten years by investing in the safest securities possible to buy—First Mortgage Real Estate Bonds.

In an unusual book you are told exactly how to discover the fortune that lies hidden in your salary. It tells you how much to set aside each month to accumulate $10,000, $25,000, or even $50,000 in a certain time. It outlines an unusual plan for the scientific accumulation of money. It shows how you can create a good sized estate through investing in Forman First Mortgage Real Estate Gold Bonds—all without risk or speculation of any sort. Mail the request blank for your copy.

GEORGE M. FORMAN & COMPANY
105 W. Monroe St.
Dept. A-833, Chicago
100 E. 42nd St., New York

40 Years Without Loss to a Customer



GEO. M. FORMAN & COMPANY
105 W. Monroe St.,
Dept. A-833, Chicago, Ill.

Please mail me without cost or obligation, a copy of your Free book, which contains tested plans for Building a Fortune.

Name .....
Address .....
City ..... State .....

The Home Workshop

Testing a Car's Camber and Caster

By Ray F. Kuns
Principal, Automotive Trades School, Cincinnati, Ohio

WHILE "toe-in" is perhaps the most important of the three fundamental elements of design in a front axle as explained in the January issue, caster and camber are likewise important. They are, however, far less understood by the average driver, for they are designed and built right into the axle.

Camber is illustrated below. Engineers have built this into the axle in order to insure long life of spindles and bearings, as well as ease and safety of steering. Since most artillery type wooden wheels have been built with a dish, the camber allows the weight coming on the tire and spokes to be transmitted in a direct vertical line through the hub and spindle bearings to the spindle body.

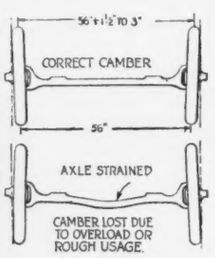
Overloading a car sometimes destroys the camber

With the present-day tendency toward wire and particularly disk wheels, this feature is of lesser importance, except in bringing the load more nearly under the king-pin or pivot pin in the steering knuckle. This prevents road shocks from being transmitted to the steering wheel.

If one carefully observes approaching cars, the camber will be visible. In the case of the Ford car, the camber is about 3 in.; that is, the tops of the front wheels and tires are 3 in. farther apart than the tires at the bottom, which is approximately 56 in. from center to center where they are in contact with the road.

SINCE this feature cannot be built into the rear wheels, the stripped chassis has the appearance of having a wider tread at the front than at the rear.

When a car has been overloaded to the extent that the front axle is sprung downward in the center, the camber is taken out. Looking at a car in this condition from the front, the bottoms of the tires show farther apart than the tops. This puts a dangerous amount of strain on the spindles and front-wheel bearings, since the point of contact on the street is so far removed from a vertical line through the pivot pin.



Camber and how it is lost

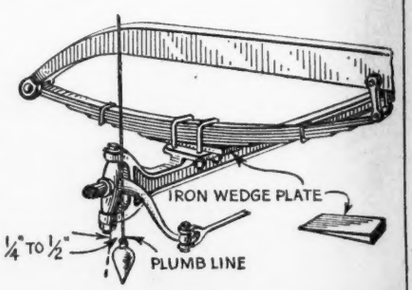
There is only one way to put camber back into the front axle, once it is gone. The job must be rebuilt; if the bushings are worn, they must be replaced; if spindle bodies are strung, they must be replaced; if the axle beam is sprung, it must be straightened or replaced entirely.

Caster is provided by the car builder when he arranges the spring mounting in such fashion as to throw the top of the pivot pin back of the bottom of the pivot pin, as indicated in the illustration below. Not a great deal of caster is required, but its benefit is evidenced when, in rounding a turn in the road, front wheels aline themselves with the straightaway without assistance from the driver.

Caster often is lost through the flattening of the front springs. Having them re-arched sometimes will help.

In some cases it is well to make a steel block or wedge as illustrated. This is bolted up under the bottom leaf of the spring with the thick part of the wedge to the rear end. When the spring clips are drawn tight, the wedge will throw the top of the pivot pin back and the bottom forward.

Again, in the case of a Ford in which the "wishbone," or front radius rod, has been sprung through striking the curb or bad ruts, the caster may be gone entirely. In this instance, indeed, the top of the king-pin may be ahead of the bottom. So serious is this condition that it is folly to attempt to use the car, since it will get out of control quickly.



Using an iron wedge to restore caster, and testing with a plumb line

The safest thing is to replace the radius rod with a new one, thus insuring the proper amount of caster. When this is not possible, the rod may be straightened and a test of caster made with a plumb bob, as shown.

A NEAT and serviceable check strap for an automobile door can be made from two strips cut crosswise from an old inner tube and trimmed to the proper size to fit the U fastener already on the car. One rubber ring is slipped inside the other to give double strength.—C. C.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

"Automatic Tools!

Here's a great line— Let me show you."

THIS is the way Millers Falls salesmen show our Automatic Tools to the hardware trade. We only wish we could put this sample roll before all you men who prize the best tools for the sake of the best work.

These fine automatic tools of ours are new enough to have all the good features, old enough to be thoroughly tested—but you know Millers Falls.

Here's the line at a glance:

Spiral Ratchet Screw Drivers—3 sizes—with and without Automatic Return.
Automatic Drills—5 styles.
Ratchet Screw Drivers—3 styles—sizes for everything.
Chuck and Drills—for spiral ratchet screw drivers.
Socket Wrenches—for "Radio" ratchet screw driver.

Names and descriptions don't tell half the story. You ought to *see* these tools. Look them over in the hardware store. You'll probably *want* all of them. Those you buy you'll like better and better the longer you use them.

Send for circular describing our Automatic Tool Line

MILLERS FALLS COMPANY
Ⓘⓢ **Millers Falls, Mass.**
28 Warren St. New York — 9 So. Clinton St. Chicago

Ⓘⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

A Necessary "Tool" For Your Workshop

FOR the man or boy who has a home workshop, Lee Union-Alls are a handy "tool" to have about. All that is necessary when you want to get busy is to slip into them and start your work. They cover the body from head to foot and can be worn over other clothing. They save clothes, also. And they save time where the hours for such work are limited.

Wear Lee Union-Alls, the *original* one-piece work suit, worn by thousands of mechanics, shopmen, garage workers and industrial workers. Lee Union-Alls are quality-built—close-woven cotton fabric, riveted rustproof buttons, reinforced strain points—fully guaranteed to give satisfaction. They give solid comfort, long wear, and are neat in appearance. Accept no substitute—look for Lee on the buttons. Thousands of live dealers sell Lee Union-Alls. Ask your dealer today!

Lee Union-Alls

THE H. D. LEE MERCANTILE CO.
Kansas City, Mo.

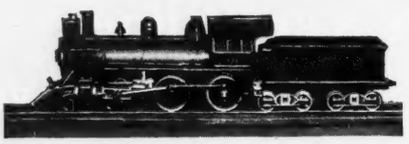
Trenton, N. J. South Bend, Ind.
Minneapolis, Minn. San Francisco, Cal

Lee Overalls and Work Shirts are other items in the famous Lee line. They are quality-built, also.

The Home Workshop

Simplified Railroad Model-Making

By Edward E. de Lancey



THERE is great fascination in model-making. Such remarkably realistic locomotives, cars, boats, and machines can be made even by beginners with limited experience and tool equipment that POPULAR SCIENCE MONTHLY *has arranged for a series of articles on this subject. They are addressed to beginners who never have made a model. Although they describe the construction of specific models, they are really on the general principles of model-making. The methods can be applied in making many kinds of models. Indeed, a model-maker hardly ever cares to copy an existing model; he wishes to make something a little different. That is the charm of amateur model-making — no two models are alike. This is the first article of the series, which is the work of Edward E. de Lancey, an enthusiastic model-maker of many years' experience.*

IN THIS series of articles, I am addressing men and boys who are enthusiastic concerning railroad matters and are mechanically inclined, but have had no experience in model-making and possess only a meager outfit of tools.

In making your own outfit according to your own ideas there is incomparably greater satisfaction than in merely collecting models. It develops ingenuity, patience, and forethought in a way peculiar to itself. Also, it enables you to make repairs or alterations under conditions that otherwise might lead to the laying aside or abandonment of a purchased model or mechanical toy.

The accompanying photographs show what has been accomplished with a few purchased parts and a minimum of tools and money. I do not pretend to be a machinist and have never possessed a lathe or other machine tool. I never could do a thoroughly workmanlike job of soldering, but, on the few occasions when it was unavoidable, have had it done for me. This is also true of the lettering on the cars.

The 4-4-0 steam locomotive and tender shown at the top of the page was made before I ventured into electricity, but is shown as a matter of interest. Its one-tube boiler was purchased in London in 1877 and its cylinders, eccentrics, wheels, and boiler fittings were bought in Boston or New York in following years. It has Stephenson's link motion, a blower, and exhausts up the stack.

Its gage, which is 3 in., was chosen unfortunately. It is too wide for the best results and it compelled the adoption of the same gage for the electric locomotives, motor-trucks and Pullmans built subsequently. The drawings in the following articles, therefore, will show a gage of 2½ in., but otherwise will represent a scale of ½ in. to the foot. These factors are a trifle inconsistent because your finished work will represent a gage of 5 ft. instead of the 4 ft. 8½ in. standard. This discrepancy will not be noticeable except to a trained eye, but will make your work accord with a favorite model gage on both sides of the Atlantic. I suggest that you stick to the 2½-in. gage throughout. It might prove helpful should you have an offer for your work.

In the next article I shall show a form of motor-truck that, with such adaptations as your resourcefulness may suggest, will suit any small motor.

The locomotive and baggage car below both have an electric drive

Commuters' car and Pullman (left); electric locomotive and car (below)

How to Cut a Glass Circle

TO CUT a circle of glass from a square piece, first mark the glass with a circular glass cutter and then mark four diagonal lines with a straight glass cutter from the circumference to the corners. Turn the glass over on a flat surface and tap lightly with a pointed tool such as a cold chisel just over the markings. With a little practice, it will be found quite easy by this method to accomplish apparently difficult feats in cutting glass.—ERNEST T. ADAMS, Fort Monroe, Va.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

KLEIN PLIERS

THE pliers in your tool box come near being the most all-around useful tools you have. No wonder you fellows are particular about them, when you buy!

The man who works with tools for the pleasure he gets out of it can't do better than to take a tip from the professional electrician and the skilled mechanic. They prefer Klein's!

Naturally there is a reason. The shape, for instance, of any Klein Plier is the result of years of design and redesign. The keen knives are individually tempered to keep their cutting edge for years of service. The easy spring of the handles and the balance of the tool is made just right for maximum comfort. Every Klein Plier is drop-forged from tool steel, and each process of its manufacture is subject to exacting inspection.

They are gluttons for punishment and will last you for years!

For the man who works with tools for the fun he gets out of it—three pairs of Klein's will about do.

Ask your hardware dealer to show you a pair of 8" Klein's Side Cutting, and a pair of 6" Klein's Oblique. You'll need as well a pair of 6" Klein's Long Nose.

Your hardware dealer carries a full line—look them over next time you are in!

Mathias KLEIN & Sons
Established 1857 Chicago Ill USA

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

FREE
1925 ATLAS
With Maps of New Europe

To readers of this magazine who take advantage of this offer now made in connection with

Webster's New International Dictionary

The "Supreme Authority"

A complete reference library in dictionary form, with 3000 pages and type matter equivalent to a 15-volume encyclopedia, all in a single volume, can now be yours on the following remarkably easy terms:

The entire work (with FREE 1925 Atlas)

DELIVERED FOR $1.00

and easy monthly payments thereafter (in United States and Canada). You will probably prefer the beautiful India Paper Edition which is

REDUCED ABOUT ONE-HALF
IN THICKNESS AND WEIGHT AS COMPARED WITH THE REGULAR EDITION

Over 407,000 Vocabulary Terms and in addition, **12,000 Biographical Names,** nearly **32,000 Geographical Subjects, 3,000 pages. 6,000 Illustrations.** Constantly Improved and Kept Up to Date. Copyright 1924.

To have this work in the home is like sending the whole family to college. To have it in the office is to supply the answers to countless daily questions.

To Those Who Send This Coupon *NOW!*

G. & C. MERRIAM CO.,
Dept. S, Springfield, Mass.

Please send me free of all obligation or expense a copy of "Dictionary Wrinkles" containing an amusing "Test in Pronunciation" (with key) entitled "The Americanization of Carver"; also "125 Interesting Questions" with references to their answers, and striking "Facsimile Color-Plate" of the new bindings. Please include specimen pages of India and regular paper with terms of your free Atlas offer on Webster's New International Dictionary to POPULAR SCIENCE readers.

Name.....

Address.....

Exhibit Your Invention
. . at the . .
EXPOSITION of INVENTIONS
Write for information
THE AMERICAN INSTITUTE
OF THE CITY OF NEW YORK
47 West 34th Street, New York City

ZIP-ZIP

THOUSANDS of boys are made happy with this wonderful Zip-Zip shooter, something every boy wants and never gets tired of. Zip-Zip shooter is scientifically and practically made; boys, if you like hunting and outdoor sports, get a Zip-Zip shooter with plenty of pep and force and learn that quick and sure aim. If your dealer happens not to have them, order from us. Zip-Zip shooter complete 35c or three for $1.00; send stamps, coin or money order.

AUTOMATIC RUBBER CO., Dept. 22, COLUMBIA, S. C.

The Home Workshop

An Inglenook Bench of Simple Design

By J. T. Garver

THIS oak bench is a useful piece of furniture in almost any room or nook, especially in the hall, in front of a fireplace or before a window.

The seat board, *A*, is 1 by 14 by 24 in.; the top rails, *B*, are 1 by 3 in. and have beveled ends so that the top and bottom edges measure 19 and 19½ in. respectively. The end boards, *C*, are 1 in. by 11 in. wide at the top and 14 in. wide at the bottom. They are sawed out to a depth of 3 in. at the bottom to form the four feet. The oval holes and scrolls are sawed with a coping- or jig-saw. The pattern for one-half of these ornaments first should be drawn on paper or cardboard and cut out or folded over so that the other half may be made perfectly symmetrical.

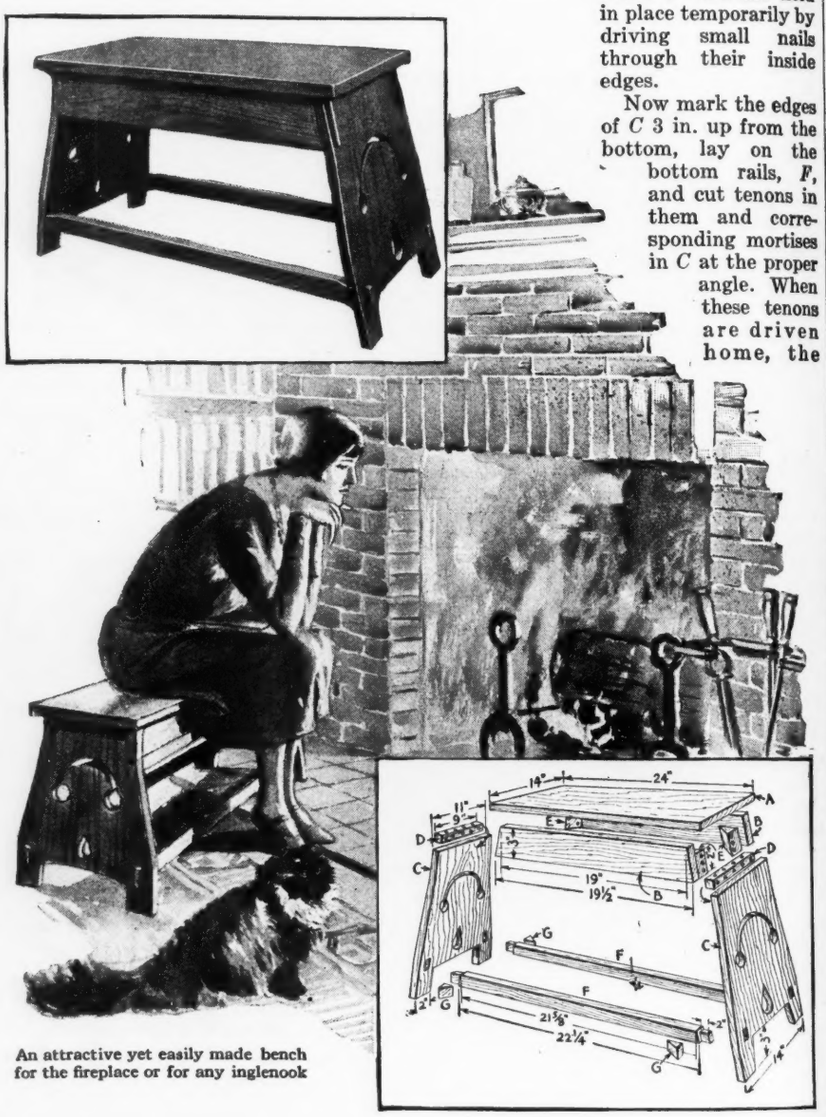
The cleats, *D*, are 1 by 1½ by 9 in., and, after being fitted, are bored with a 3/16-in. bit and countersunk for 1½- and 2-in. screws. The four triangular blocks, *E*, have faces 1½ by 2 in.

After the bottom rails, *F*, are cut 1 by 2 by 26 in., the parts may be assembled in their relative positions and any fitting and beveling done to make the joints perfect. The top edges of the parts *C*, *D*, and *E* are beveled so that they are level with the rails *B*. The parts *B*, *C*, *D*, and *E* then are placed in their proper position on the bottom of the seat board *A* and are held in place temporarily by driving small nails through their inside edges.

Now mark the edges of *C* 3 in. up from the bottom, lay on the bottom rails, *F*, and cut tenons in them and corresponding mortises in *C* at the proper angle. When these tenons are driven home, the inside measurement between the top and bottom of the end boards, *C*, will be 19 and 23 in. respectively. Four triangular pieces, *G*, are fitted in the outside angles of *F* and *C*.

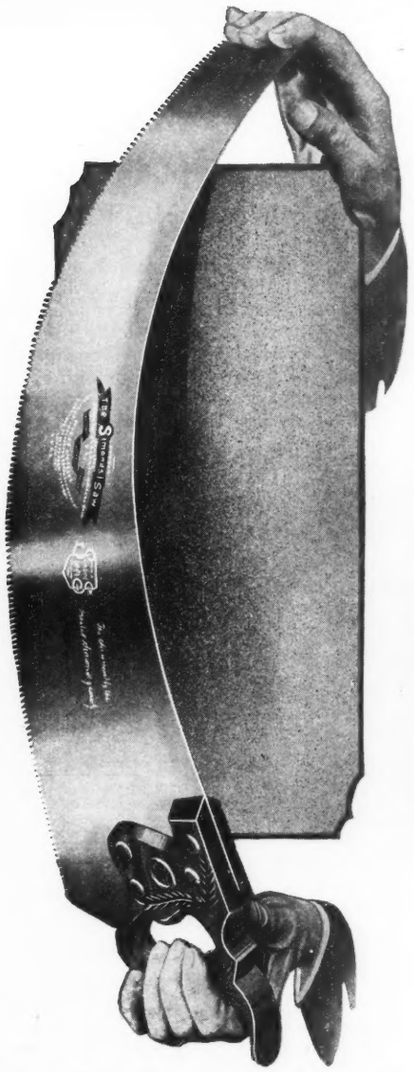
Glue then is applied and the screws are driven home. Any surplus glue should be scraped off carefully.

After the glue sets thoroughly, the piece should be well sanded, all sharp edges rounded off and stain or die applied. The wood then is waxed and rubbed thoroughly, several coats being given.



An attractive yet easily made bench for the fireplace or for any inglenook

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



SIMONDS
BLUE RIBBON HAND SAWS

IT is difficult to appreciate the difference between a Simonds saw and an ordinary saw—until you get BEHIND a Simonds.

THEN you will find that Simonds steel, Simonds design and Simonds workmanship have combined to produce a saw that SINGS its way through a board quickly, cleanly and easily.

The Simonds Blue Ribbon saw is typical of the quality that Simonds has been putting into cutting steel since 1832. The name Simonds on the blade of ANY cutting tool is your guarantee of quality. It will pay you to insist upon a Simonds saw.

SIMONDS SAW AND STEEL COMPANY

"*The Saw Makers*" Fitchburg, Mass. *Established 1832*

Branch Stores and Service Shops in Principal Cities

SIMONDS

Pronounced SI-MONDS

SAWS FILES KNIVES STEEL

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Could she earn her own living?

SHE'S your daughter—and perhaps you hate to think of her having to work for a living.

But this sort of thing does happen in very nice families—and too often the girl is utterly unprepared for any well-paid occupation. So she takes a poorly-paid job as sales girl, waitress or clerk.

* * * *

It's different when there is a Corona in the home. A child who has learned to use Corona Four, with its standard office keyboard, can operate any office machine—and you've provided her with the best kind of an insurance policy against the day when she may be forced to support herself.

Corona Four costs only $60. Easy terms if desired. Look for *Corona* in your phone book or write Corona Typewriter Co., Inc., 112 Main St., Groton, N. Y.

CORONA

$3.50 Cash

RADIO
Storage "B" Battery
22 Cells 24 Volts *Lasts Indefinitely—Pays for Itself*

Economy and performance unheard of before. Recharged at a negligible cost. Approved and listed as Standard by leading Radio Authorities, including Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Leiaz, Inc. and other important institutions. Equipped with *Solid Rubber Case*, an insurance against acid and leakage. Extra heavy glass jars. Heavy rugged plates. Order yours today!

SEND NO MONEY Just state number of batteries wanted and we will ship day order is received. Extra Offer: 4 batteries in series (96 volts), $15. Pay expressman after examining batteries. 5 per cent discount for cash with order. Mail your order now!

WORLD BATTERY COMPANY
1219 So. Wabash Ave., Dept. 80, Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp. $13.50; 120 Amp. $14.50; 140 Amp. $16.00. All equipped with Solid Rubber Base.

World STORAGE BATTERIES FOR RADIO

WJZ - WEAF - WGN - WJS - KHJ - KGO - KFAF - WJY - KOP

The Home Workshop

How You Can Make a Round Frame

Solidly carved effect obtained easily by unique method of built-up construction

ELABORATELY carved as it appears to be, the picture-frame illustrated presents no great difficulties in construction. Any amateur woodworker who is willing to take the necessary time and pains can duplicate it. That is because its delicacy and beauty are not the result of carving the design out of the solid, but of building up the frame in sections.

This circular picture-frame of rich appearance can be duplicated without much skill in carving

Although cherry was used, almost any close-grained cabinet wood will serve. The four main segments are cut with a compass saw from stock 11/16 in. thick so as to form a frame 4½ in. wide and 23¾ in. in diameter. If available, a bandsaw or jigsaw may be employed to good advantage for sawing these.

Smooth the segments carefully with a spokeshave and sandpaper. Using a sharp knife, router, and gouge, cut the edges of these parts, which are to form the front frame, to the correct profiles and make the ⅛-in. deep channel, as indicated in the working drawing.

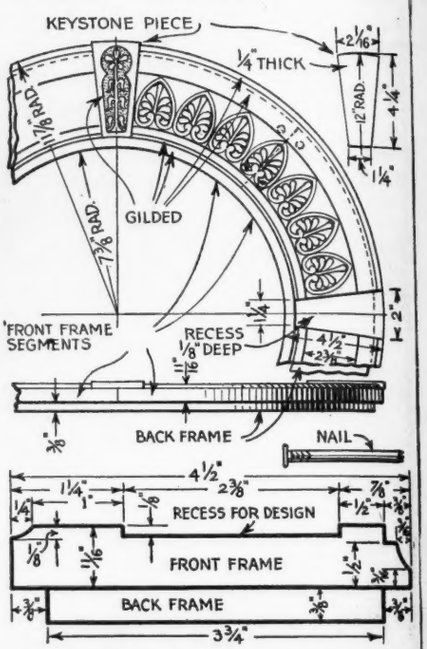
The back frame is composed of four segments ⅜ in. thick and 3¾ in. wide. These are fastened to the heavier segments with glue and flat-headed wood screws from beneath.

The keystone-shaped pieces that cover the joints of the front frame are let into corresponding mortises cut ⅛ in. deep. The design on the keystones is cut with a small chisel and the background is roughened with a nail filed as shown.

The main border design, one-quarter of which is shown, is cut out from stock ⅛ in. thick, the saw following the heart-shaped outline of each unit of the ornament. One segment is glued in each of the four circular recesses of the main frame and then the leaves are carved slightly on the surface, as made clear in the photograph.

The frame may be finished in any way desired, but the one illustrated was varnished and then gilded where marked in the drawing below. Finally a piece of picture glass 15⅜ in. in diameter is fitted into the rabbet and the picture framed.

Following the same general principle of construction, frames may be made any size needed and either delicate or heavy, as best suits the picture to be framed.—WILLIAM J. EDMONDS, JR.



Details of the front and back frames and method of applying the carved ornamentation

Old Music-Stand Is Converted into Ornamental Tea-Wagon

AN INDICATION of what can be done in converting old and useless pieces of furniture into articles of real value is given in the accompanying photograph. This is a tea-wagon made from an old walnut music-stand with fretwork ends.

Part of the legs were cut off to make the top 30 in. high, rails put on under the top, and a drawer added. The additions were made of walnut and the whole piece was refinished with shellac and wax.—H. CALDWELL, Toronto, Can.

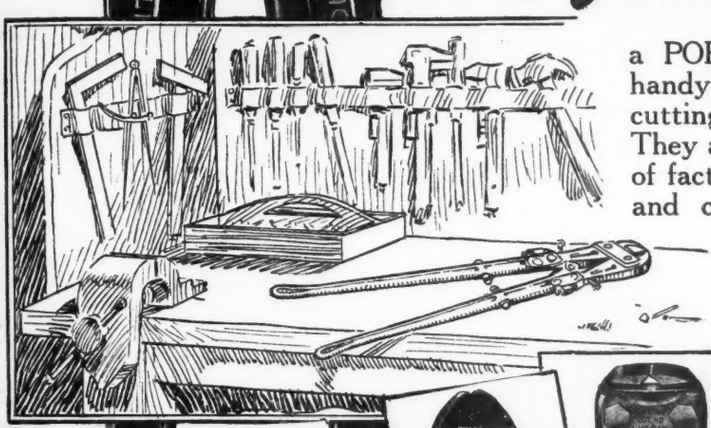
WHEN whitewashing, add a little salt or kerosene to the mixture. This will help prevent the whitewash from rubbing off.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

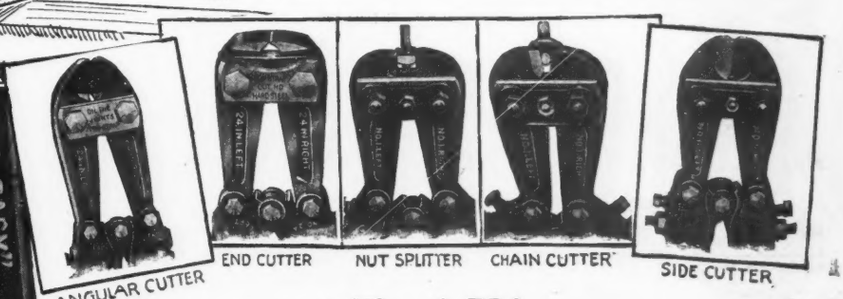
Porter's Bolt Clippers and Wire Cutters

Husky, two-handed tools for cutting rods, bolts, heavy wire and chain, and for splitting nuts. Capacities up to ¾" annealed bolts in the thread. Time and money savers.

On every Workbench

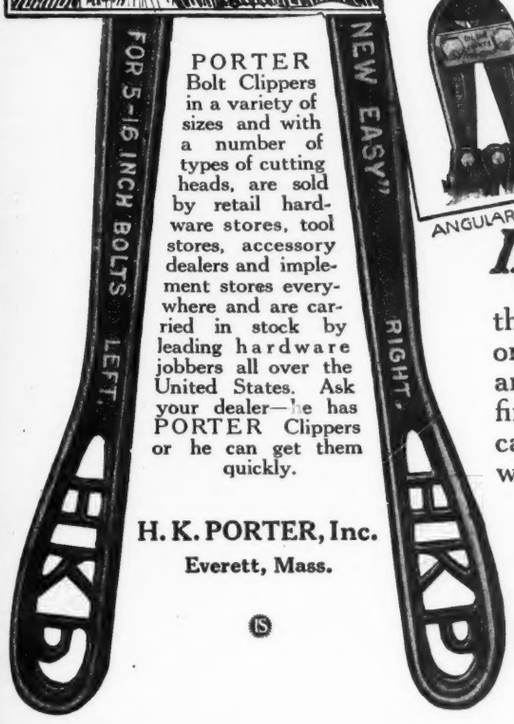


a PORTER Bolt Clipper will come in handy for a hundred and one jobs, from cutting curtain rods to fender bolts. They are used on production in thousands of factories and power plants, on building and construction work and in garages everywhere. They are invaluable around the farm, machine shop and on the home work-bench.



In every Tool-Kit-

the PORTER Bolt Clipper meets emergencies—on railway maintenance and construction, telegraph and telephone work, building-wrecking, fire departments, road-building, lumber camps, mines, shipyards—wherever heavy rod, bolt, chain and wire cutting is to be done quickly and easily, a PORTER Bolt Clipper "saves the day."

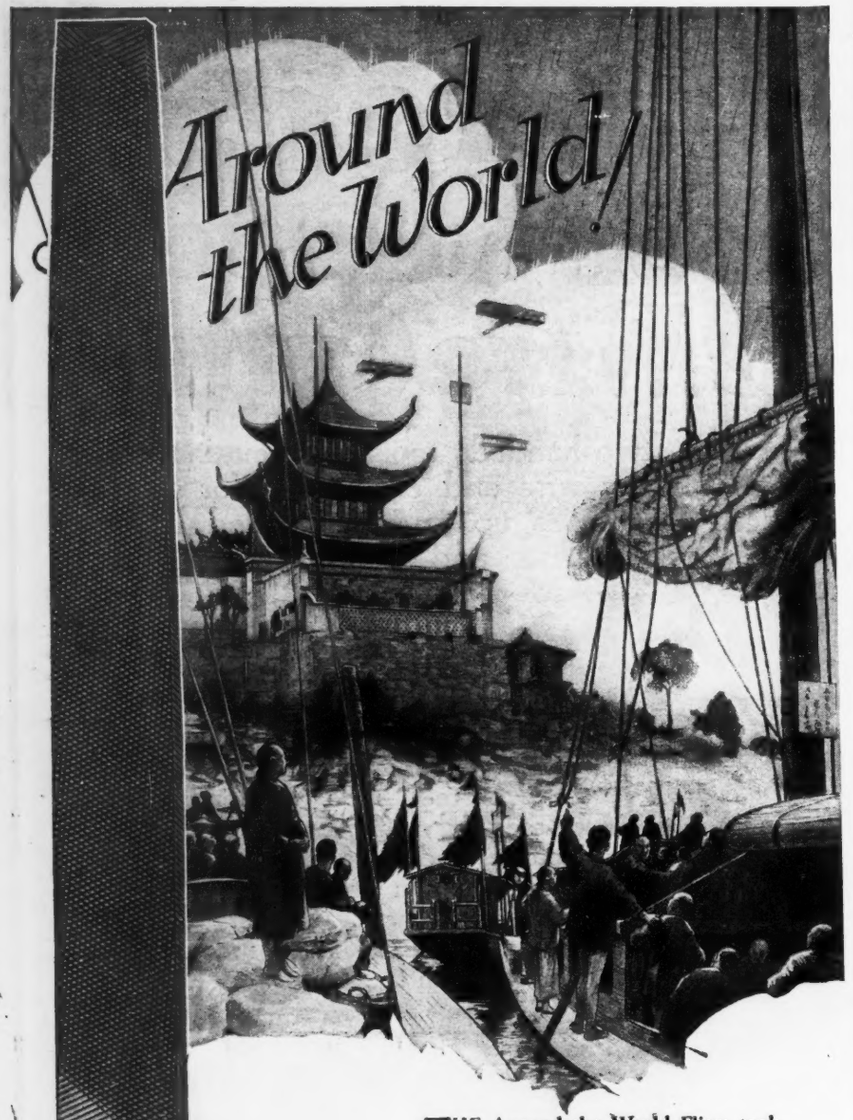


PORTER Bolt Clippers in a variety of sizes and with a number of types of cutting heads, are sold by retail hardware stores, tool stores, accessory dealers and implement stores everywhere and are carried in stock by leading hardware jobbers all over the United States. Ask your dealer—he has PORTER Clippers or he can get them quickly.

H. K. PORTER, Inc.
Everett, Mass.

Ⓢ

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



THE Around the World Fliers took nothing for granted—they included NICHOLSON Files in their *original* equipments.

Yet these aviators could have obtained files bearing the NICHOLSON crossed-file trade mark at most stopping points on their lengthy flight!

Around the World—in every nation where high-grade tools are necessities in industry—NICHOLSON Files are on sale.

NICHOLSON Files cut sharply from the first stroke. Every one is a mechanically perfect tool, made with great skill and care of the best grade of file steel, then repeatedly tested to assure its reaching your hands entirely free from defects.

Your Hardware dealer sells NICHOLSON Files. Let him help you select those your requirements demand.

NICHOLSON FILE CO.
Providence, R. I., U. S. A.

NICHOLSON U.S.A. TRADE MARK

NICHOLSON FILES

~a File for Every Purpose

The Home Workshop

Blueprint Contains Details of Kitchen Cabinet Work-Table

IN THE kitchen a convenient, well-designed work-table is as important as a substantial, well-built bench is in the shop. To build one is not especially difficult, provided a good design is followed, such as that contained in Blueprint No. 27 in the Home Workshop series below.

The new blueprint for this month (No. 40) is a writing-desk in Sheraton style. This is illustrated on page 98.

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	*Title*	*Price*
1.	Sewing Table	25c
2.	Smoking Cabinet	25c
3.	Book Trough End Table	25c
5.	Kitchen Cabinet	25c
6.	Two-Stage Radio Receiving Set	25c
8.	Shaving Cabinet	25c
9.	Arbor with Gate and Seats	25c
10.	Porch Swing	25c
11.	Bench and Tilt-Top Table	25c
12.	Electric Washing Machine	25c
13.	Tea Wagon	25c
14.	Toy Train, Horse, and House	25c
15.	Home Workshop Bench	25c
16.	Inlaid Radio Cabinet	25c
17.	Cedar and Mahogany Chest	25c
18.	Telephone Table and Stool	25c
19.	Grandfather's Clock	25c
20.	Flat Top Desk	25c
21.	Colonial Writing-Desk	25c
22.	Girl's Cabinet and Desk	25c
23.	Pergola Garage	25c
24.	Gateleg Table	25c
25.	Sailing Outfit for Canoe	25c
26.	Baby's Crib and Play Pen	25c
27.	Kitchen Cabinet Work-Table	25c
28.	Pullman Play Table	25c
29.	Toy Tea Cart, Garage, etc.	25c
30.	Tool Cabinet, Bench Hook, etc.	25c
31.	Priscilla Sewing Cabinets	25c
32.	Chinese Game Table	25c
33.	Pullman Dining Alcove	25c
34.	Trellises for House and Garden	25c
35.	Simplified Radio Cabinet	25c
36.	Rush-Bottom Arm-Chair	25c
37.	Simplified Bookcase	25c
38.	Sheraton Table	25c
39.	Salem Chest of Drawers	25c
40.	Writing-Desk in Sheraton Style	25c

Name .....
(Please print)

Street .....

City and State .....

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

SAND'S LEVELS

Built-in Accuracy for Builders

THE factory built-in accuracy of Sand's Levels is permanent, therefore dependable. Workmen who value their reputations won't trust themselves to adjust a level—they leave that to factory experts. The accuracy of every Sand's Level is sealed in and double sealed. You can bank on it now—you can bank on it ten years from now.

A Level Is Known by the Company It Keeps

Just peek in the tools kits of the master craftsmen on any job—you'll find a Sand's level most every time. Because these men know good tools, and because they won't gamble with their own reputations by using anything else.

START THE SEASON RIGHT WITH A SAND'S

Ⓢ

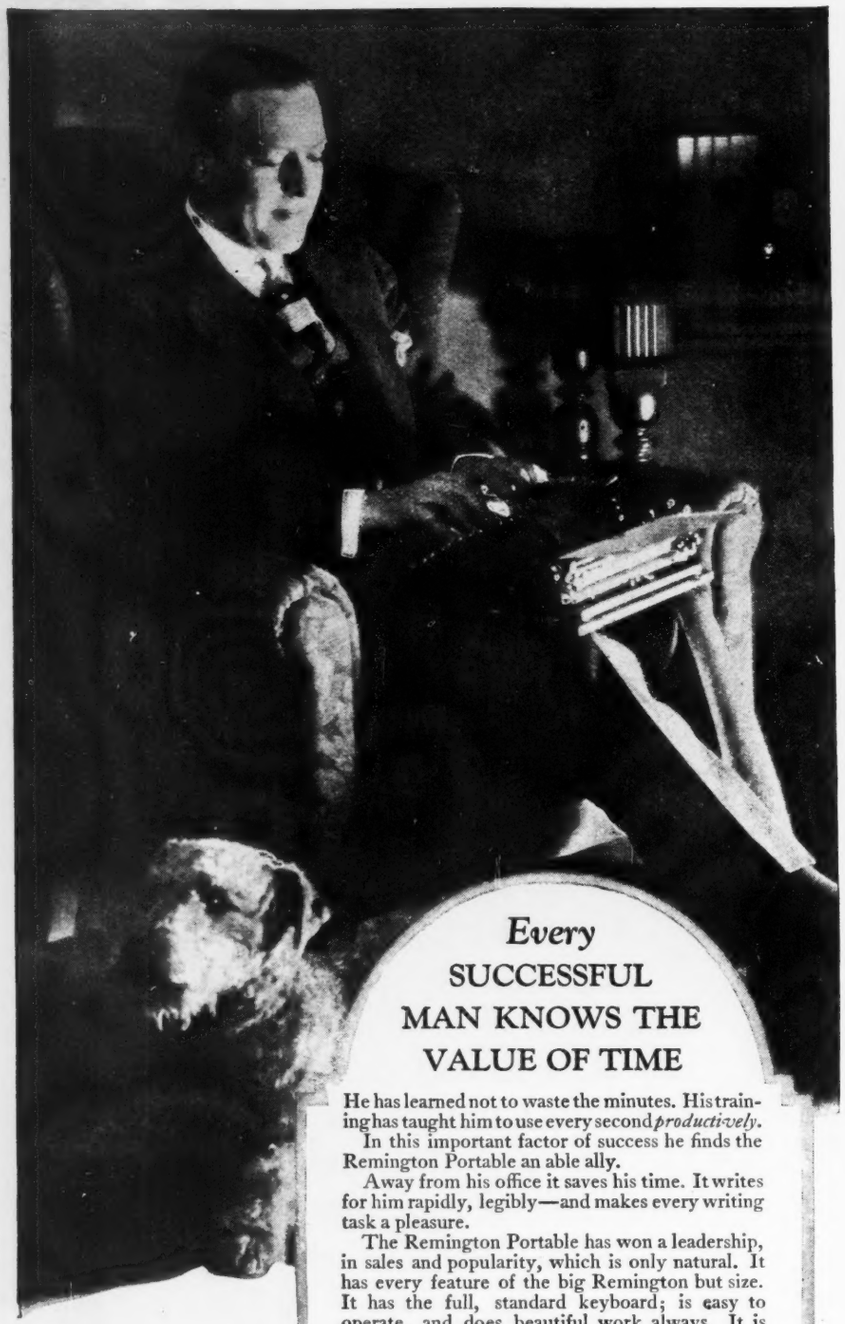
At Good Hardware Stores Everywhere

Wood and Aluminum Levels for Every Purpose

SAND'S LEVEL & TOOL CO.

5849 Fischer Avenue - - - Detroit, Michigan

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



Every
SUCCESSFUL
MAN KNOWS THE
VALUE OF TIME

He has learned not to waste the minutes. His training has taught him to use every second *productively*.

In this important factor of success he finds the Remington Portable an able ally.

Away from his office it saves his time. It writes for him rapidly, legibly—and makes every writing task a pleasure.

The Remington Portable has won a leadership, in sales and popularity, which is only natural. It has every feature of the big Remington but size. It has the full, standard keyboard; is easy to operate, and does beautiful work always. It is light, compact, reliable, durable—and it carries its table on its back, so you may use it anywhere, at any time.

Remington Portable is sold everywhere. Easy payment terms if desired. Write today for illustrated "For You—For Everybody." Address Department 67.

REMINGTON TYPEWRITER CO.
374 Broadway, New York—*Branches Everywhere*

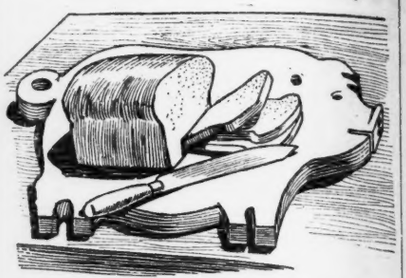
We believe we make the best typewriter ribbon in the world—and its name is PARAGON

Remington Portable

The Recognized Leader in Sales and Popularity

The Home Workshop

Breadboard Shaped like Pig Is Amusing Kitchen Novelty



FOR this odd-shaped breadboard, plane smoothly a piece of hard wood, preferably maple, 18 by 24 in. and at least 1 in. thick. Draw the outline of the pig and cut it with a coping-saw, although it is advisable to have the board bandsawed if possible.

Bore a ½-in. hole in the center of the tail, so that the board can be hung on a hook. Then rasp the edges smooth. Saw a small kerf for the mouth, work out the snout as shown, and burn in the eye, eyebrow, and curve of the tail with an old soldering iron or iron rod. Sandpaper thoroughly, finish with three coats of boiled linseed oil, and trim the edges with gray or blue paint or enamel.—J. C. WILLIS, West Kelso, Wash.

Oak Hall Table

(*Continued from page 110*)

or beveled corner joints. The side pieces, *G*, are 2½ in. wide and 4 ft. long; the end pieces, *H*, are 2½ in. wide and 2 ft. 2 in. long. They are nailed to the legs in such a manner as to form a recess 1 in. deep to accommodate the top boards. The inside of the frame should measure 24 in. by 3 ft. 10 in.

On the wooden top, when it is in place, is laid a piece of fiber-board 2 ft. 2 in. wide and 4 ft. long, without tacking. Dark green, drill-backed, imitation leather is cut 2 ft. 9 in. wide and 4 ft. 7 in. long for the top cover. It is lapped at the corners, pulled taut, and tacked every inch along the bottom edges of *G* and *H*.

The ¼ by ¾ in. by 6 ft. piece of oak is cut into 76 blocks, ¾ in. square. After being smoothed with file and sandpaper, these are set edgewise and split with a knife. The parts of each pair are kept together. Then the lower half of each is bored or drilled with a small hole and a No. 18, ¾-in. brad is inserted. Attach one of these blocks 1 in. from each corner, as shown. Then apply glue and stick on the outer half of each block. After the corner blocks are in place, mark the intervening spaces into even intervals and drive in the ornamental "nails," which can be done as you make them.

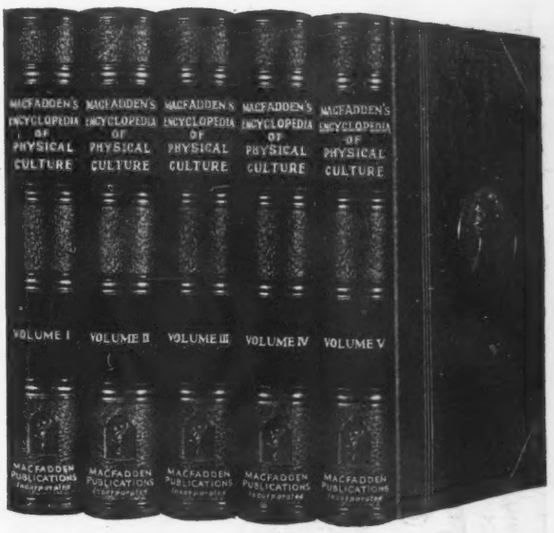
These nails, as well as the imitation leather, are very durable. The table illustrated was built exactly according to these specifications and has been in everyday use for 12 years.

If desired, the feet, *C*, may be recessed from the bottom to take concealed ball-bearing casters. The finish may be light golden oak or whatever oak stain is preferred.—T. G.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

But ONE Person in Three Enjoys Good Health

At least 60% of physical and mental misery is preventable and curable. In fact the life of most persons would be prolonged 15 years if they knew how to rule their health as they do their actions.



EVERY year more than ten thousand people die of bronchitis, sixty-four thousand die of pneumonia, seventy-five thousand die of kidney trouble, fifty thousand die of respiratory disease, one hundred and six thousand die of tuberculosis, approximately eighty-five thousand die of influenza, and more than ten thousand die of intestinal trouble.

Barring accidents and suicides, only a small percentage of these thousands should die.

It is a fact that only about one person out of three enjoys good health. And those who are physically a little "off" right now will more than likely be the ones to succumb to preventable diseases this year. And they are the ones who should not die.

Nature is constantly warning you of impending sickness. Seemingly trivial symptoms tell of serious troubles taking root in your body. And yet, ninety-nine people out of every hundred will absolutely ignore these danger signals. As long as they are not flat on their backs, they will fool themselves into believing that they are all right.

Nature is merciless. If you do not understand her laws and her methods of preventing and curing sickness, you suffer. She knows no excuses—she accepts no apologies.

The Average Person Pays Thousands of Dollars in Doctor's Bills

Those who do not know Nature's methods of preventing and curing sickness are ill an average of 21½ days each year. In fact, it is estimated that the average person in a lifetime spends $4,100 on doctor and hospital bills, loss of time from business, medicine and other expenses due to illness. Thousands of people are living half-powered lives because they are ignorant of the laws of Nature. Many of these people will fill an early grave, when they might easily have lived to enjoy a ripe old age.

What would it be worth to you to be able to instantly identify in its earliest stages any sickness or disease that might overtake you or any member of your family? To enjoy perfect health, almost complete freedom from sickness, doctor and hospital bills, and no days of suffering and worry, or salary lost through sickness?

How to

possess exhilarating health every day in the year
know your own body
eat for health
diet for the cure of disease
know the art of food preparation
build a powerful physique
correct physical imperfections
become a physical director
avoid unhappy marriages
avoid disease
fast as a curative measure
cure by hydropathy (heal by the use of water)
apply all methods of drugless healing
give first aid in emergencies
apply home treatment for disease
recognize diseases by manifestations
build nervous energy
treat the common forms of disease
understand the process of reproduction
benefit by laws of sex and marriage
treat diseases of women
diagnose diseases
have healthy and vigorous children
treat female disorders
treat male disorders
obtain virility and manhood
care for the complexion
manicure; care for the hair and feet
cultivate the mind

These are only a few of the matters explained in the Encyclopedia.

The Encyclopedia of Physical Culture

This marvelous work gives invaluable information on fasting, diet, exercise, and hydropathy for both health and beauty building. It gives thorough and extensive treatment on the laws of sex, the attainment of virile manhood and womanhood, and happy successful parenthood, together with details for correct diagnosis and treatment of all sexual diseases. It contains many handsome charts on anatomy and physiology.

It is neither dull nor technical, but is comprehensive and complete in every sense. It is the crowning effort of Bernarr Macfadden's rich, full experience in the science of health and physical culture. You haven't any idea how valuable it will be to you, or how many dollars it will help you save each year. What, for instance, would it be worth in actual dollars to you to be able to instantly identify in its earliest stages any sickness that might overtake you or any member of your family? What would it mean to you to have glorious health, almost complete freedom from sickness or disease, no doctor's bills to meet, no hospital bills to pay, no days of suffering or worry, no salary lost through absence from business?

"One of the Best Works on Health Ever Published," says one writer

Thousands of letters have been written to Bernarr Macfadden commending his Encyclopedia of Physical Culture. One (name furnished upon request) says "Permit me to thank you for the great work by Mr. Macfadden—the Encyclopedia of Physical Culture—which I got from you some time last month. I have read much of it already, and consider it to be one of the best books on health ever published. I wish to thank Mr. Macfadden for his great work. The Encyclopedia is going to be my best doctor now and always."

Another man writes: "I cannot express the wonderful value of these great books and feel they will lead me to a successful married life, as I have recently married. They are a plain, sensible and priceless guide to a perfect physical life."

A New Edition Just Off the Press

Five big editions of this popular work have been exhausted. And now the sixth edition—greatest of all—has just come off the press. This edition has been completely revised at great expense. Scores of new illustrations have been inserted. The binding has been changed to a beautiful all Fabrikoid, more durable than leather. Altogether it is the finest edition of the Encyclopedia ever issued.

10 Days' Free Examination of Entire Set—No Money Needed

This is the most liberal offer we have ever made on the Encyclopedia—10 days' examination of the entire set at no expense to you. There is no money needed—no deposit to pay. Just fill in the coupon and we will send the five volumes to you, all shipping charges prepaid, for your inspection.

Take ten days to examine the set. Then if you decide to purchase send us only $2.00 as your first payment. Additional payments may be made at the rate of only $3.00 a month until the total cost of $35.00 has been paid.

ENCYCLOPEDIA of PHYSICAL CULTURE
New 6th Edition ~ Completely Revised

MACFADDEN PUBLICATIONS, INC.
Dept. P. S. 3, Macfadden Building
1926 Broadway, New York City

Send me for 10 days' inspection the five volumes of the Encyclopedia of Physical Culture. If I find the set satisfactory I will either send $2.00 in ten days and $3.00 a month until $35.00 has been paid, or $31.50 cash. If I decide not to keep the books I will return them in 10 days postpaid.

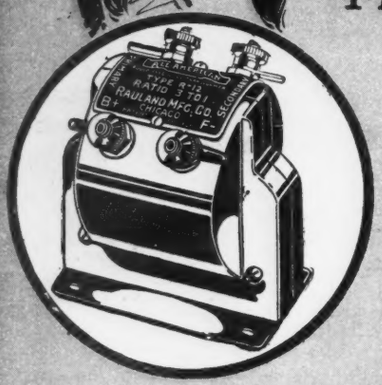
Foreign orders—cash in advance

Name.....
Occupation.....
Residence.....
City and State.....
Employed at.....
Business Address.....

Examine the Entire Set for 10 Days FREE!

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

What *Reliable Radio* Means to You



¶ An assurance that, when you try out a hook-up, you can rely on your instruments to give you a *fair test.* ¶ A knowledge that each part has been put to such searching tests that its proper performance, *under any conditions*, is assured. ¶ In short, a conviction that each individual part *will continue* to do its work *year after year.*

Two pleasant hours spent with the RADIO KEY BOOK will acquaint you with the essential facts of modern reception, and how to enjoy it at its best. Ten cents—coin or stamps—brings the KEY BOOK.

RAULAND MFG. CO.
Pioneers in the Industry
2668 Coyne St. Chicago

IS

ALL-AMERICAN
Guaranteed Radio Products

Standard Audio Transformers
3 to 1 Ratio, type R-12...$4.50
5 to 1 Ratio, type R-21... 4.75
10 to 1 Ratio, type R-13... 4.75

Power Amplifying Transformers (Push-Pull)
Input type R-30.....$6.00
Output type R-31..... 6.00

Rauland-Lyric
A laboratory grade audio transformer for music lovers. R-500.....$9.00

Universal Coupler
Antenna coupler or tuned r. f. transformer. R-140.....$4.00

Self-Tuned R. F. Transformer
Wound to suit the tube. R-199 $5.00. R-201A $5.00

Long Wave Transformer (Intermediate Frequency)
(15-75 kc.) R-110.....$6.00

10,000 Meter (30 kc.) Transformer
Tuned type (filter or input). R-120..$6.00

Radio Frequency Coupler (Oscillator Coupler). R-130 $5.00

Super-Fine Parts
Consisting of three R-110's, one R-120 and one R-130, $26.00

All-American Reflex Receivers
Complete receiving sets with extraordinary range, volume and selectivity. All parts mounted on panel and baseboard, with full instructions for wiring. All-Amax Junior (one-tube).....$22.00
All-Amax Senior (three-tube) $42.00

ALL-AMERICAN
Largest Selling Transformers in the World

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

The Home Workshop

Furnace Warms Hotbed Built outside Cellar Window

Built directly outside a cellar window, this small, handy hotbed can be cared for comfortably. The plants are reached by standing on a bulb storage bin

A Vest-Pocket Lighting Plant

(*Continued from page 106*)

and dash switches for each light. For bright lighting 32-candlepower bulbs are used, and for closets he uses 8-candlepower lights. Two chargings of 4 hours a week are usually enough to keep the batteries fully charged. Two or three lights are lit every evening.

Two 120-ampere-hour batteries have sufficient reserve so that there should be no dull lights. At a 10-ampere charging rate, two days' running will completely restore them. However, as one bulb uses only about 2 amperes an hour, one can see readily that in an evening very little current is drained from the batteries.

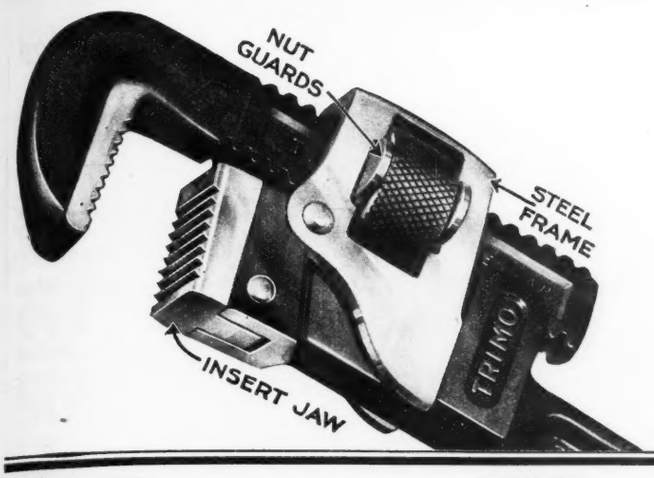
It may be well to state that if the third brush of the generator is moved in the direction of the rotation of the armature, the charging rate can be increased, and vice versa.

The system described has been in use a year and has given all the service that could be expected of it. It will not, of course, give sufficient current to operate flatirons, toasters, and the like, but it gives a clean, white light at very low cost. It saves the work of keeping oil lamps clean and is much safer.

A Decorative Desk

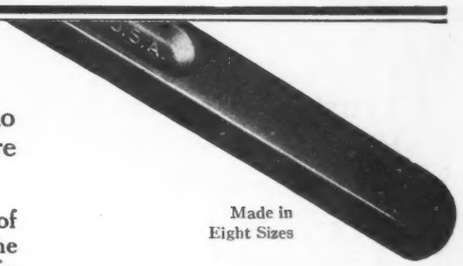
(*Continued from page 98*)

FF Drawer-front rail, doweled, ⅞ by 2½ by 24½ whitewood, 1 required
GG Runners (tenoned one end), ⅞ by 2 by 13½, whitewood, 2 required
HH Drawer guides (nailed in), ½ by 1 by 13, whitewood, 2 required
II Top of base, ⅞ by 18 by 28, 5-ply with veneered edges (or solid), 1 required
JJ Mortise locks, 1½ in. to pin, brass selvage, 2 required
KK Socket casters, 2½ in., brass, 4 required
LL Veneer for bandings, 1/32 in. thick, mahogany or walnut to contrast with other wood used
MM Top fasteners, ⅛ by ¾ by 1⅝, iron, 8 required
NN Molding for interior, 10 ft., 1 required
OO Draw knobs, stock, brass, 2 required
PP Handles for top sections, if desired, stock brass, 2 required
QQ Hinges, 1½-in. wrought-brass desk butts, 2 required
RR Dowels, ⅜ in. diameter



The Trimo Pipe Wrench is made with Steel Handles in sizes 6, 8, 10, 14, 18, 24, 36 and 48 inches. Made in Wood Handles in sizes 6, 8, 10 and 14 inches.

7 Reasons Why You Should Buy This Famous Pipe Wrench



Made in Eight Sizes

IF you're a man who buys tools strictly on their merits and who cannot be influenced by the small difference of a few cents, here are 7 reasons why you'll want a TRIMO Pipe Wrench.

1. You can make your TRIMO last for years and years because ALL of its parts are renewable. This feature alone (especially of the INSERT JAW in the handle) makes TRIMO the cheapest wrench in the long run.
2. You know how annoying it is to have a wrench lose its adjustment in close quarters. TRIMO won't do that—the nut guards prevent it.
3. Wrench frames sometimes break when put on a tough job. TRIMO'S won't—its frame is made of specially tested steel. TRIMO means SAFETY—always.
4. TRIMO'S long, steel handle guarantees extra leverage—less exertion—less hard work.
5. Run your fingers along TRIMO'S deep-milled teeth—they WON'T SLIP—yet they WON'T LOCK on the pipe.
6. Take a TRIMO in your fist—its perfect balance fairly tickles the hand of a good mechanic.
7. We've been making and perfecting this wrench for nearly 40 years—your guarantee of quality, materials and workmanship.

Whether you're a skilled mechanic, radio fan, inventor, householder or handy man—you'll find daily uses for a TRIMO Pipe Wrench. Once a buyer, you'll never stop being a booster.

Made in Four Sizes

TRIMONT MFG. CO.

Roxbury, Mass.

America's leading wrench makers for nearly 40 years.

TRIMO

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

R7483

GENERAL UTILITY KNIFE. A blade for every purpose. Large spear blade for heavy work. Small clip blade. Pen blade. Stag handle. Nickel Silver bolsters, lining, and shield. Length, closed, 3⅜ inches.

Trust the Name Remington—

the Hallmark of Good Steel

YOU can't tell whether a knife blade is made of good steel by looking at it, feeling it, or blowing your breath on it. But if you could tell quality in one of these ways, you would always buy a Remington knife.

For over a century Remington has been developing scientific, thorough, and exact heat-treatments for steel. Remington's methods of forging, hardening, and tempering insure blades with the remarkably keen, durable, and uniform cutting edges which are a distinguishing feature of all Remington pocket cutlery.

You will appreciate the practical advantages of Remington knives designed expressly to meet the exacting requirements of the carpenter and skilled mechanic. Add one of these useful Remingtons to your kit. Here are two practical patterns illustrated. Others in various combinations of blades and handles may be seen at your dealer's. If he hasn't them he will gladly order them for you. Send for a circular describing Remington carpenter's and mechanic's knives.

R4223

CARPENTER'S KNIFE. Large, heavy spear blade. Sheepfoot blade for scribing and coping. Pen blade. Stag handle. Nickel Silver bolsters and shield. Brass lining. Length, closed, 3¼ inches.

Remington Arms Company, Inc. Ⓢ
Established 1816
25 Broadway New York City

Remington Pocket Knives

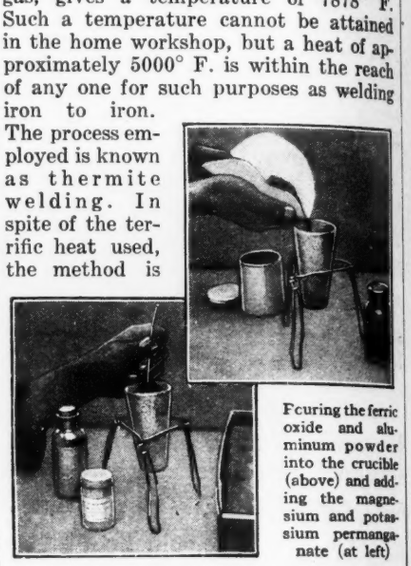
Rifles Ammunition Shotguns Game Loads Cutlery Cash Registers

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

THE welding torch or blowpipe, when used with both acetylene and oxygen gas, gives a temperature of 7878° F. Such a temperature cannot be attained in the home workshop, but a heat of approximately 5000° F. is within the reach of any one for such purposes as welding iron to iron.

The process employed is known as thermite welding. In spite of the terrific heat used, the method is safe if a reasonable caution is observed.

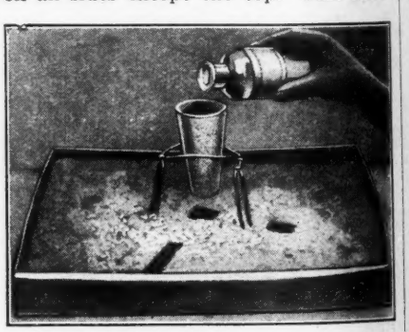


Fcuring the ferric oxide and aluminum powder into the crucible (above) and adding the magnesium and potassium permanganate (at left)

Thoroughly mix ferric oxide and aluminum powder, using about equal quantities of each; a slight excess of aluminum powder is an advantage. Place this mixture in a conical container, such as an old tin funnel or crucible with the bottom hole covered with a piece of heavy paper.

At the top of the powder spread about a half teaspoon of powdered magnesium. This is topped with a level teaspoon of potassium permanganate heaped in the center. Make a depression in this heap.

Fill a box with sand and on the sand place the iron to be welded. Make a form of the sand to surround the joint on all sides except the top. Just above the mold, place the thermite mixture, held by means of a wire tripod.



Dropping glycerine into the potassium permanganate to set off the welding mixture

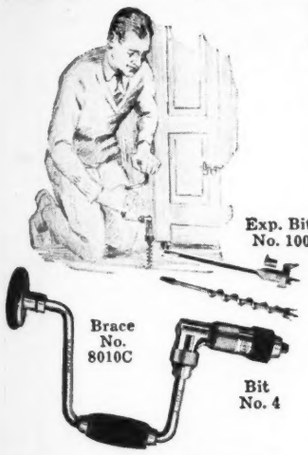
Place from 4 to 6 drops of glycerine quickly in the depression of the potassium permanganate and stand away. A stream of white-hot molten iron soon will run into the mold and form a weld. Large pieces should be preheated to redness.

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 23.

To the Handy Man in Your Home---

EVERY home has its "Handy Man." Perhaps it's the man of the house; Grandpa; Junior; or maybe it's Mother herself who is called upon to do those little repair jobs around the house.

They seem to pop up every day. Each night when father gets home there is some minor thing to be done. The front door may need rehanging or the hinges tightened. There's a call for a good sturdy screw driver—and perhaps a keen-edged chisel. It doesn't take long when you get at it—and our Handy Man takes real pleasure in doing it if he has good tools to work with.



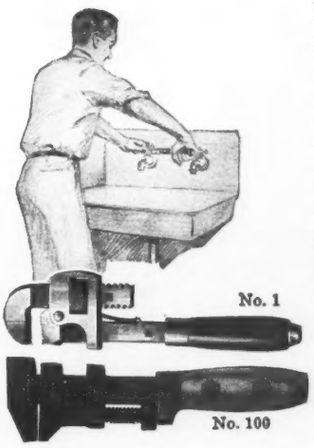
How about fixing a drain for the refrigerator? That's something for which Mother has been asking for months. A good brace—like the Pexto Samson and a sharp bit—and it's done in ten minutes. Then isn't Mother pleased!

A new lighting fixture—the cord to the electric iron—hanging pictures—friend Handy Man is going to need some good pliers to make those jobs easy.

And then those little emergency plumbing jobs—the trap to the sink—and such like—no plumber for a little job like that; a dependable pipe wrench and the Handy Man has earned his title again.

One other tool he is going to want—a monkey wrench—really indispensable. Renewing washers on the faucets and a hundred other uses.

Then again home simply isn't without a hammer. Perhaps it's chair-tips or slides to put on—curtain fixtures to put up—a crate to open. There's a big difference in hammers, too. A good one lasts so much longer nothing else will do.



A bit of sheet metal to cut and nail above the hot-water heater; it would ruin Mother's shears to cut it with them—and Dad's hands would get pretty sore, too. But a pair of Pexto Snips will make an easy job of it. They're built for just that work. Include them in the list.

And so the story goes; endless little jobs easily done with good tools. A source of real pleasure to do these little things yourself, aside from the actual money savings. How proud Mother is that you can do them—the enjoyment you get from it may make it a real hobby—and an economical one too.

No more borrowing from Jones or Smith—as these jobs come up. Start a little Tool-Kit of your own. And just a hint—you can't go wrong on Pexto Tools.

Ask your dealer—and look for the Pexto Oval shown below. It is your assurance of getting Worth-While Tools.

Booklets covering our important lines are available for free distribution.

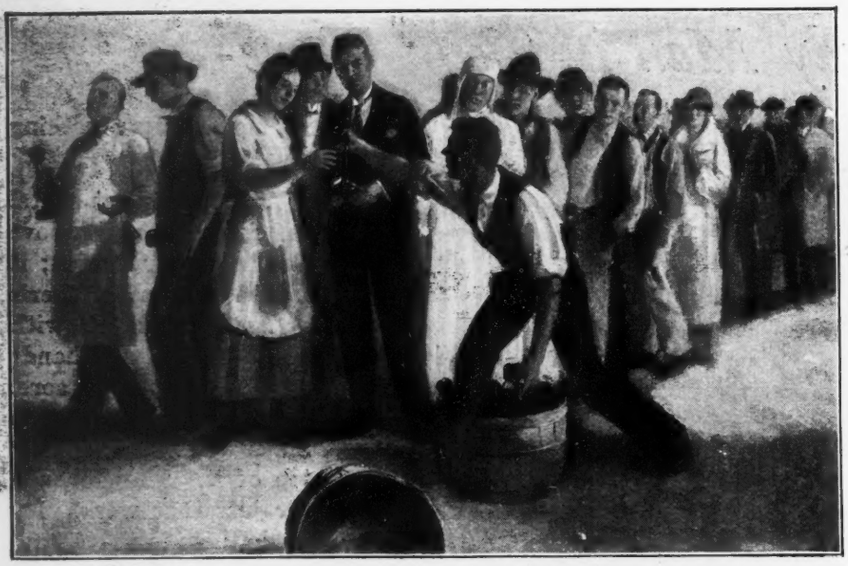
Pexto Tools are carried by practically all progressive dealers everywhere.

PEXTO

WORTH-WHILE TOOLS

The Peck, Stow & Wilcox Company
Southington, Connecticut, U. S. A.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



Give us Telephones

Following the war, when business and social life surged again into normal channels, there came the cry from homes, hospitals, schools, mills, offices—"Give us telephones." No one in the telephone company will ever forget those days.

Doctors, nurses and those who were sick had to be given telephones first. New buildings, delayed by war emergency, had to be constructed, switchboards built and installed, cables made and laid, lines run and telephones attached.

The telephone shortage is never far away. If for a few years the telephone company was unable to build ahead, if it neglected to push into the markets for capital and materials for the future's need, there would be a recurrence of the dearth of telephones. No one could dread that eventuality so much as the 350,000 telephone workers.

Bell System engineers measure and forecast the growth of communities; cables, conduits, switchboards and buildings are planned and developed years ahead of the need, that facilities may be provided in advance of telephone want. Population or business requirements added to a community must find the telephone ready, waiting.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
BELL SYSTEM
One Policy, One System, Universal Service

$25.00 in PRIZES See top page 8 in front of book for details

Buy Now Pay Later!

Let Boice Help You Build It!

No matter what you want to build. Boice can help you. He'll send you the

Boice-Crane Junior Saw

or any other Boice-Crane machine on monthly payments. He gives you unsurpassed prices and values with a positive money-back guarantee. Machine shown will saw, sand, grind, miter, rabbet, tenon, etc. Sturdy, accurate, economical. Saws 1 ¾" stock. Sold with or without motor.

Write today for Descriptive Catalog of Bench Saws, Drills, Jointers and Band Saws and the Boice E-Z-Pay Plan.

W. B. & J. E. BOICE
Dept. P. S. 3-A, Toledo, Ohio
"World's Largest Makers of Small Bench Machines"

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

The Home Workshop

Easily Built Model Plane

(*Continued from page 97*)

are 1/8 in. wide and 3/64 in. thick, for these need to be the strongest. The middle ones are 1/8 by 1/32 in., and the two short ones, 3/32 by 1/32 in.

To fasten the braces to the beams, force their ends completely through the slits so that they extend on the other side (No. 1, Fig. 2). Before gluing and binding them, however, the frame should be trued up so that the beams are straight. To do this, slide the braces one way or the other in the slits. Then glue and bind, and after the glue has hardened, cut the protruding parts flush with the beam. The braces that cross each other also should be bound at their intersection.

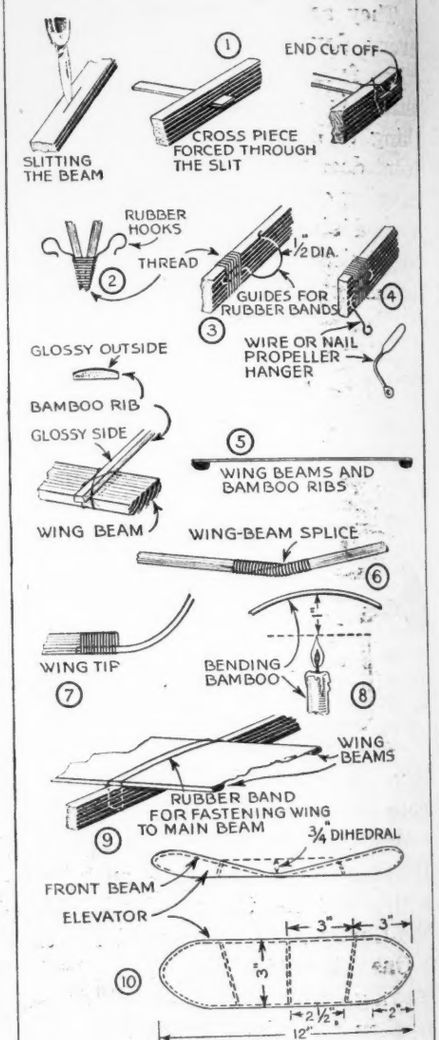
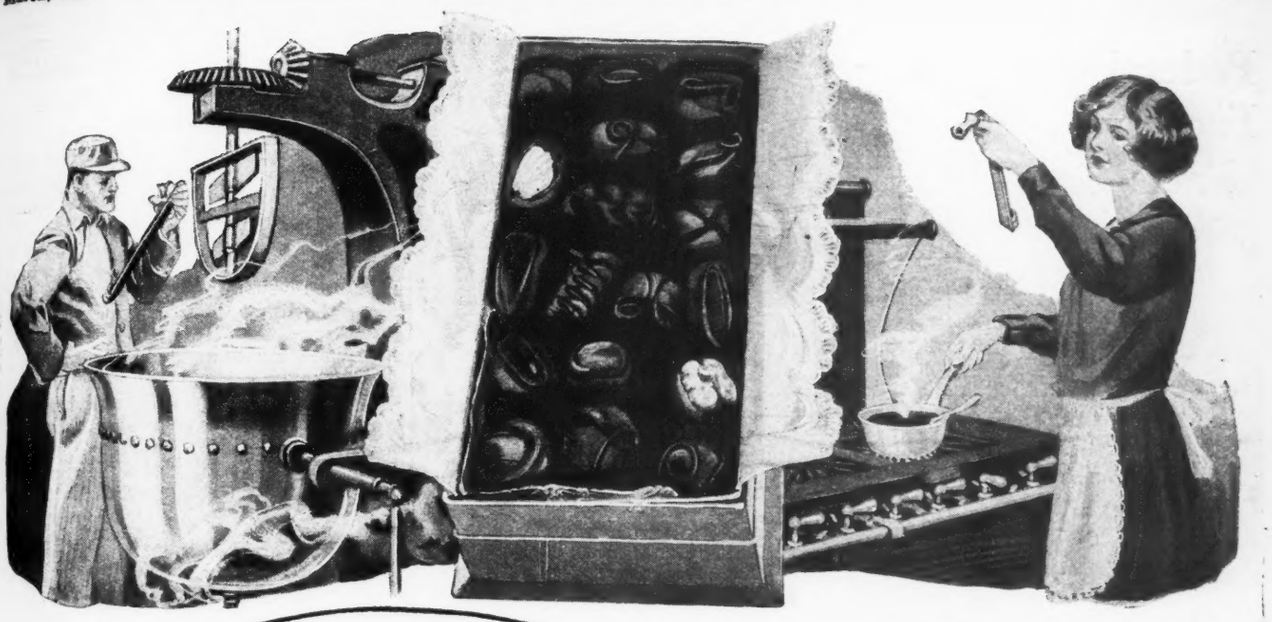


Fig. 2. Connecting cross pieces to beams, making wire fittings, and other details

In the drawings three wire fittings, which look like hooks, are along each side of the frame. These are guides for the rubber bands (No. 3, Fig. 2). They are very important, for they serve to strengthen and keep the frame more rigid when it is subject to the heavy stress from the strong rubbers. These guides

(*Continued on page 130*)



YOU KNOW WHAT TO EXPECT

WHEN YOU BUY a box of candy made by a reputable manufacturer you know exactly what you are going to get. There is no guesswork, no uncertainty, no gamble in candy that is made on a wholesale basis. The quality *must* always be the same.

The difference of two degrees in boiling a 200-pound batch of candy will ruin the whole batch. But modern candy-manufacturers assure themselves against loss and insure uniform results by using *Tycos* Heat Indicating, Recording and Controlling Instruments—the *Sixth Sense of Industry.*

And by using Taylor's Home Candy Maker's Thermometer, you can make candy at home of the same uniform quality obtained by the manufacturers in making millions of pounds of candy.

Whether you are in the business of making candy or steel, canning fruits and vegetables, or baking bread, if your manufacturing processes include heat treatment there are *Tycos* Heat Indicating, Recording or Controlling Instruments that will help you get the uniform results that are absolutely essential to production on a volume basis.

MANUFACTURERS

If your manufacturing problems require the indicating, recording or controlling of heat, there is a type and style of instrument in the *Tycos* Line of 8000 varieties that will help you.

Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of *Tycos* to your particular manufacturing problem.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO

Tycos—for the Home

***Tycos* Office Thermometers**
An aid in promoting human efficiency.

***Tycos* Bath Thermometers**
To enable you to get the most good from your bath.

***Tycos* Home Set**
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

***Tycos* Wall Thermometers**
To help you maintain a temperature in your house conductive to good health.

***Tycos* Quality Compasses**
To show you the right way in unfamiliar country.

***Tycos* Fever Thermometers**
A necessity in every home.

***Tycos* Stormoguide**
Forecasts the weather twenty-four hours ahead with dependable accuracy.

***Tycos* Hygrometer**
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above.

Tycos—for the Medical Profession

Tycos Sphygmomanameter, Pocket and Office type
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on request.

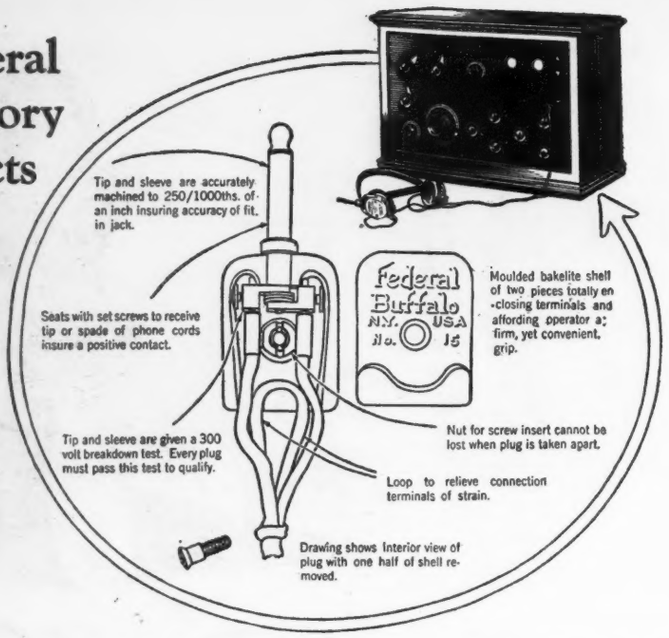
THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING · RECORDING · CONTROLLING

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Federal Factory Facts


Tip and sleeve are accurately machined to 250/1000ths. of an inch insuring accuracy of fit in jack.
Seats with set screws to receive tip or spade of phone cords insure a positive contact.
Federal Buffalo NY. USA No. 15
Moulded bakelite shell of two pieces totally enclosing terminals and affording operator a firm, yet convenient, grip.
Tip and sleeve are given a 300 volt breakdown test. Every plug must pass this test to qualify.
Nut for screw insert cannot be lost when plug is taken apart.
Loop to relieve connection terminals of strain.
Drawing shows interior view of plug with one half of shell removed.

THE plug is the *key* that unlocks the full possibilities of your receiver. No matter what you are getting off the air, you *hear* only what the plug lets through.

Buy a No. 15 Federal Plug for your radio phones or loud speaker if you want to know what your radio set can give you.

Buy a Federal Plug today—also take advantage of the other 130 standard radio parts sold under the same Federal iron-clad performance guarantee.

FEDERAL TELEPHONE MANUFACTURING CORP.
Buffalo, N. Y.

Boston
New York
Philadelphia
Pittsburgh

Federal
Standard RADIO Products

Chicago
San Francisco
Bridgeburg
Canada

Ole Evinrude's New Quick Detachable

Rowboat Motor

Weighs less than 17 lbs. per H. P. Easily carried with you anywhere you go. Fastens in a jiffy to any boat and away you go. No rowing, no work, no bother. Just ride and enjoy the greatest of water sports. Slow down for fishing. Speed up for racing.

Write for FREE Catalog

describing 12 exclusive features, especially the Propello Pump. Ole Evinrude's latest invention. Only Elto has it. Write today.

ELTO OUTBOARD MOTOR CO., Dept. W
Manufacturers' Home Bldg., Milwaukee, Wis.

Elto—The Motor that Starts with a Touch

$1 DOWN

21 Jewels

Nothing less than 21 Ruby and Sapphire jewels is good enough for Burlington masterpiece.

Quality and Style

Adjusted to the second—temperature—isochronism—positions. 25 year Gold Strata Case, in 100 designs. $1 down. Balance in small monthly payments. Send for free book.

Burlington Watch Company
19th Street and Marshall Blvd.
Dept. 13-63 Chicago, Illinois

Tests Show Ford Can Run 60 Miles on Gallon of Gas

The amazing fact that a Ford can run 60 miles on a gallon of gasoline was recently brought to light thru tests conducted by America's foremost engineers. Great strides have already been made in this direction by the recent invention of a simple attachment which can be installed in a few minutes without any alterations to motor. A. C. Winterburn made 41.4 miles on 1 gallon of gasoline after this device was attached. B. O. Weeks, famous aviator and inventor, wants agents and will send sample for trial. Write him today at 426-762 Eleventh St., Milwaukee, Wis.

The Home Workshop

Easily Built Model Plane

(*Continued from page 128*)

should be ½ in. in diameter. The part that lies next the beam should be bent in a U shape so that the guide can be bound securely to the beam.

On each beam at the rear is a wire propeller hanger (No. 4, Fig. 2). This, too, should be bent in a U shape where it lies along the beam. Particular care should be exercised in binding it firmly to the beams because it must hold the direct pull of the rubber.

If one has a steel drill, nail hangers, which are somewhat stronger than the wire, may be substituted. The nail hanger may be made by drilling a hole 1/32 in. in diameter through the flattened

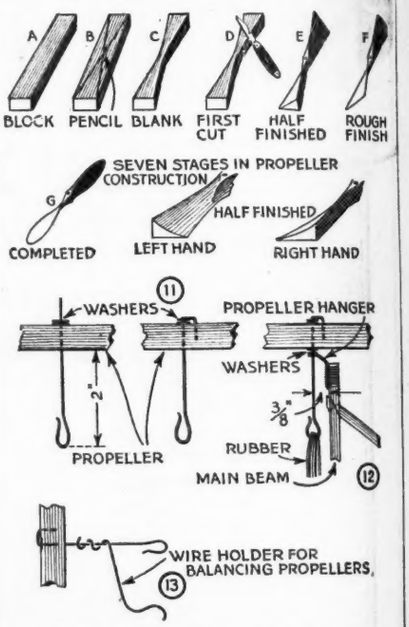


Fig. 3. Steps in whittling the airplane propellers, the propeller shafts, hanger, and wire holder for balancing propellers

head of a 1-in. brad. The part that lies along the beam also should be flattened to insure a solid fit against the beam.

For those who have scales, the frame should weigh about an ounce.

The wings are built of two pine beams with bamboo ribs and wing tips. The beams are 3/16 in. wide, ⅛ in. thick, and 29 in. long, rounded on the under side to lessen air resistance (No. 5, Fig. 2). As will be noticed in the sketches, the wing has a dihedral angle, that is, the beams bend upward at the center. In this case the upward bend amounts to 1 in. (Fig. 1).

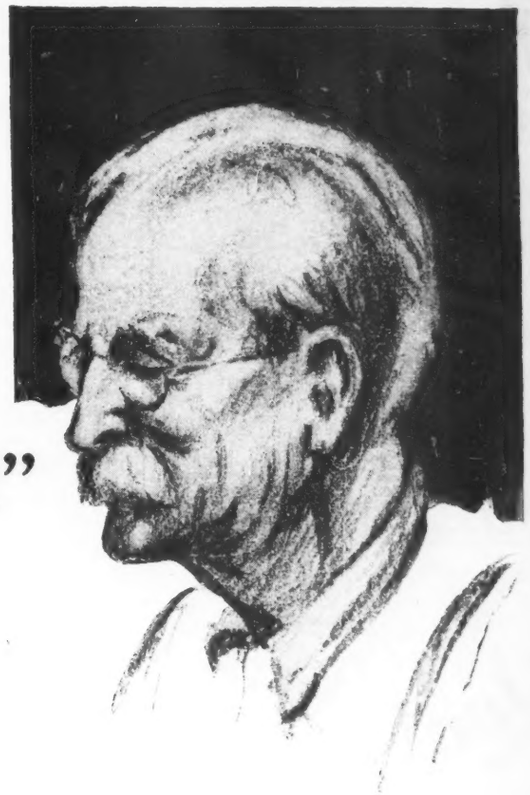
To obtain this dihedral angle, splice the beams, as in No. 6, Fig. 2, or bend them carefully over a candle flame (No. 6), holding them about 1 in. above the flame. If the wood should be cracked or scarred in bending, be sure to reinforce the weakened place by gluing and binding a piece of bamboo over it.

The ribs are made of bamboo, 1/16 in. wide and 3/64 in. thick, spaced 5½ in. apart. They should be bound to the beams after the dihedral angle has been made. The glossy part of the bamboo

(*Continued on page 132*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

"That's all I need to know— It's a Maydole Hammer!"



LOOK for the name "D. Maydole" stamped on the head. It's absolute assurance that the design, material and workmanship in that particular hammer is as near perfection as human skill, plus over 80 years of experience, can make it.

Ask any old-timer—he'll tell you there's "hang" in a Maydole Hammer that's lacking in hammers less carefully made: There's years and years of service in the press-forged steel heads: There's a grip in the claws of a Maydole that never lets go: There's a satisfaction in knowing that when you put a Maydole in your kit you've settled all your hammer troubles for a long time to come.

In 1843, David Maydole—the founder of the business—said: "I make the *best* hammer," and from that day to this, we have striven to hold the standard set.

If you are a hammer user send for our free pocket handbook 23B—it's worth a lot to a carpenter or anyone who uses hammers.

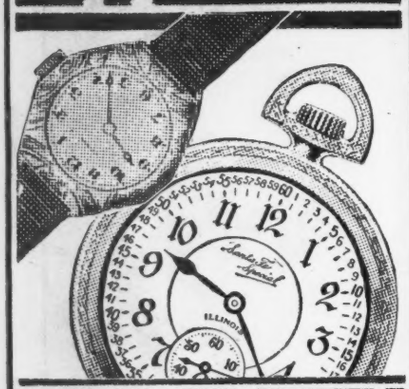
THE DAVID MAYDOLE HAMMER CO.
Norwich New York

Maydole Hammers — Makers of Your Hammer Since 1843

7610

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

sent on Approval



The 21 Jewel

Santa Fe Special

Look

21 Perfect Jewels
Adjusted to Positions
Adjusted to Temperature
Adjusted to Isochronism
Adjusted to the Second
25-Year Gold Strata Case

We will send this famous watch, express prepaid, for you to examine, to inspect, to admire, to approve, without one penny advance payment. Examine the watch and be convinced it's the best watch buy you ever saw. Just a small payment down, the balance in easy MONTHLY payments. You use the watch while paying for it.

Save ⅓ to ½ of Your Money

By purchasing this Famous Santa Fe Special Watch. Not only are you saving money from the present day prices of watches, but you can still secure the "Santa Fe Special" Watch at the same low prices and terms that have made our watches famous.

Ladies' Wrist Watches

This Artistic dependable Lady's Wrist Watch, fitted with genuine Illinois Springfield movements. A perfect timepiece. Beautiful 14-Karat white or green SOLID GOLD cases. Ask for New Watch Book showing Cases in all the new shapes and designs. Watch sent on approval and sold on payments.

Send for Free Watch Book

Clip the coupon, fill out and receive the FREE WATCH BOOK. All the newest watch case designs in white or green gold, fancy shapes and thin models are shown. Read our easy payment offer. Wear the watch 30 days FREE. Watch sent for your examination and approval without a penny down. Nothing to risk. See the watch before you buy.

Write for FREE Book Today and Select Your Watch—Mail Coupon.

SANTA FE WATCH COMPANY
380 Thomas Building, TOPEKA, KAN.
The Home of the Great Santa Fe Railway

Santa Fe Watch Co., 380 Thomas Building, Topeka, Kan.

Please send prepaid and without obligation your Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

Name .....

Address .....

The Home Workshop

Easy to Build Fast Model Plane

(*Continued from page 130*)

should be on top, as in No. 5, Fig. 2.

The bamboo wing tips should be curved over a candle flame. In order to have both wing tips of exactly the same shape, use a wide piece of bamboo in bending, and split it into two pieces after the shape has been obtained. Trim down the tips until they are 1/16 in. wide and 3/64 in. thick. The tips extend 2 in. beyond the ends of the beams.

At the end of each wing beam cut out a small piece of wood. Fit the end of the wing tip in place of this piece; glue and bind (No. 7, Fig. 2).

THE wing is covered on top with tissue paper attached to the beams with banana oil. Glue, although heavier, may be substituted for the oil. First, take a piece of paper large enough to overlap 1 in. on the edges. Apply banana oil to the middle rib and lay the paper on it immediately. Allow this to become thoroughly dry and fast before attempting to proceed with the covering.

Now, apply the oil to the beams, section by section, between the ribs, and then stick the paper to them. Before the banana oil has evaporated, work out the wrinkles in the paper. When doing this, keep the paper flat against the beams.

After the paper has been attached to the entire framework of the wing, trim off the overlap along the edges by sandpapering. The wing completed should weigh about ½ oz.

The elevator, as the small front wing is called, is constructed like the main wing, the only difference being in the main beams and the dihedral angles (No. 10, Fig. 2). The main beams of the elevator are of bamboo, 1/16 in. wide, 1/32 in. thick, and 8 in. long, placed with the glossy part on the under side. The elevator tips extend 2 in. beyond the end of the main beams, thus making the over-all length 12 in. They are 1/16 in. wide and 1/16 in. thick, and the ribs 1/16 in. wide and 1/32 in. thick.

THE dihedral angle, amounting to ¾ in. between the ribs, should be placed only in the front beam. This should be done after the framework of the elevator has been completed. The dihedral angle here is very important because a good flight is hardly possible without it.

The elevator, which is papered in exactly the same manner as the wing, should weigh no more than 1/10 oz.

The propellers are carved out of solid blocks of wood, ⅝ by 1¼ by 12 in. (*A*, Fig. 3). Draw diagonal lines from the opposite corners on the wide sides of the blocks (*B*, Fig. 3). Then with a knife cut along these lines to make the propeller blank (*C*). Before actual carving is begun, it is advisable to force a hole for the propeller shaft through the hub of the blank. This may be done by working through a straight piece of wire or by drilling.

Start cutting as shown at *D*, Fig. 3. The upper side of each blade should be flat or slightly cambered. It should be finished, except for fine sandpapering, before the carving on the under side is begun (*E*). After the final thickness of the blades has been obtained (*F*), the tips can be rounded to a more graceful shape (*G*). Then finish off the propellers with fine sandpaper.

One propeller should be left-handed and the other right-handed. This is necessary because the propellers must revolve in opposite directions on the model to keep it stable in flight.

A WIRE propeller shaft should be thrust through the hole in the hub of each propeller. Slip a few washers over the protruding end, then end the wire, as in No. 11, Fig. 3, and force it into the wood. The shafts extend from the under side of the propellers in this case because the propellers are pushers.

To balance a propeller, make a small wire holder, as in No. 13, Fig. 3, which will allow the propeller to revolve freely. Slip the shaft in this holder. The heavier blade will hang downward. Sandpaper until the blades balance. The total weight of the propellers should be about 1/3 oz.

To assemble the model, fasten on the wing and elevator by rubber bands, as indicated at No. 9, Fig. 2. Be sure that the front edge of the elevator is toward the nose (Fig. 1). Attach the propellers, as in No. 12, Fig. 3.

The power plant is furnished by 10 strands of ⅛-in. flat rubber attached to each propeller. The rubber should be strung so as to have a sag of two inches. If one cannot secure ⅛-in. flat rubber, six strands of 3/16-in. flat rubber on each propeller will serve equally well. Square rubber may be used, but it is not the best.

In flying this model, remember that it is a pusher type, and, unlike large airplanes, the small wing is in the front. The initial flights should be attempted on a fairly calm day. Wind each propeller 100 times. Launch the model with a gentle thrust slightly upward.

DO NOT be discouraged if it does not fly well at first, the trouble is probably in the adjustment. If on the first flight the model tends to point downward, it has insufficient elevation. To remedy this move both the wing and elevator a fraction of an inch forward. If, on the other hand, the model should tend to climb too rapidly and stall, move the wing and elevator backward slightly.

After one has obtained steady flights with the model, the rubber may be wound up until it has a double row of knots. If one has a winder for winding the rubber, better results will be secured.

Under fair weather conditions the model should remain in the air for about 100 seconds and fly several hundred feet. As you become more experienced, you will soon learn to adjust this model so that it flies at its best.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

DE FOREST leads again

Another jump ahead! Just out—first in 1925

DE FOREST'S greatest triumph. A truly remarkable advance in ease of operation—beauty of tone—selectivity—distance range. It uses tube detector instead of crystal.

You should see and test this instrument before you buy any set. Its refinements and improvements are too many to tell here.

Ask your nearest De Forest dealer to bring it to your home and show you how simply and perfectly it operates. It will be hard for you to let him take it away.

Price Range $125 to $200

THE NEW

DE FOREST D-17

REG. U.S. PAT. OFF.

Made by De Forest Radio Company, Jersey City

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School
Dept. H-375
Drexel Ave. and 58th St., Chicago

American School
Dept. H-375 Drexel Ave. & 58th St., Chicago
Send me full information on the subject checked and how you will help me win success.

.....Architect	.....Business Law
.....Building Contractor	.....Lawyer
.....Automobile Engineer	.....Machine Shop Practice
.....Automobile Repairman	.....Mechanical Engineer
.....Civil Engineer	.....Shop Superintendent
.....Structural Engineer	.....Employment Manager
.....Business Manager	.....Steam Engineer
.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Wireless Radio
.....Vocational Guidance	.....Undecided

Name.....

Address.....

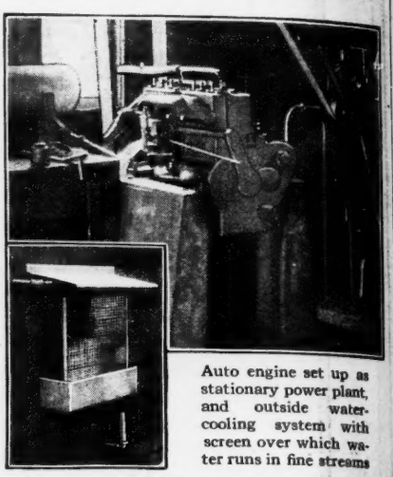
The Home Workshop

Old Auto Engine Drives Machines

THE owner of a small carpenter-contractor shop in a Mid-Western state installed power for his machine tools by utilizing an old but sound auto engine. The engine was overhauled and then mounted on two concrete standards capped with channel iron.

Being of the heavy, flat-faced type, the flywheel is belted directly to a line-shaft pulley overhead. The throttle is regulated from the left side, a heavy wire and ratchet serving to hold it in any desired position. The spark is adjusted in the same general way, but held with a bolt. The outfit develops 11 hp. at 1200 r. p. m.

The water-cooling system is simple, yet rather unique. The circulation pump is connected by pipes with the outside cooler illustrated in the smaller of the accompanying photos. The hot water finds an outlet in a series of small, closely spaced holes drilled in the upper horizontal pipe. To this pipe a section of ¼-in. mesh-wire screen is soldered. A trough of sheet iron at the bottom collects the cooled water, which is drawn back into the engine by the return pipe.



Auto engine set up as stationary power plant, and outside water-cooling system with screen over which water runs in fine streams

How to Build a Strong Teeter-Totter

THIS teeter-totter will appeal to any boy or girl. It is sturdy, accident-proof, and comfortable.

The materials required are:

1 plank 2 in. thick, 18 ft. long
1 broom handle
1 3-ft. length of 4 by 6 in. wood
1 6-ft. length of 4 by 4 in. wood
1 10-ft. length of 1 by 4 in. wood
1 2-ft. length of cedar post, 6 in. in diameter
Spikes in three sizes

The teeter-totter ready for use and view of the central supports, which are A-shaped

The plank is shaped at each end with a draw-knife. The round post is smoothed up and cut in half. One end of each part is reduced to 2 in. in diameter for a distance of 2 in. These round tenons are driven into 2-in. holes bored through the center of the plank ends 20 in. from the ends. A hardwood wedge is driven into each tenon from the under side and the pieces also are toe-nailed for greater security. Sections of broom handle are set through the uprights to serve as grips.

The support is built up of 4 by 4 in. legs, which rest in pairs, like A's, upon two bed pieces of the same material. The bearings are cut from 4 by 6 in. pieces. The axle or pivot is a piece of 4 by 4 nailed to the under side of the plank at the exact center with the protruding ends made perfectly round and saturated with grease. Notches in the 4 by 6 in. pieces form the bearings; these also should be as smooth as possible and well greased.

The plank wood should be without knots or flaws of any kind and straight-grained so that it will not warp. Test it for balance and if one end is heavier than the other, hew that end down until the balance is perfect. Give all parts a thin priming coat, and two coats of good paint, or finish it with spar varnish.
—D. V. H.

A Rollicking Crib for Baby

THIS spring-suspended baby crib or swing is supported by two rectangles of heavy wire, one 12 by 16 in. and the other 18 by 30 in., held together by strips of canvas folded and sewed for strength.

The bottom portion or crib proper is of 20-oz. duck sewed to form a compartment about 8 in. deep. The iron ring at the top is fastened to a spiral spring hanging from the porch ceiling. The mosquito-netting cover is made of four triangular-shaped pieces.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

The Easiest Way To Repair Punctures

Get Your Vulcanizer Now—
you may need it this week

A Packard is no better than a Ford when it comes to punctures. That's liable to happen to anybody. But you can be prepared for such emergencies, the same as nearly three million motorists who always carry Shaler Vulcanizers in their cars. They want to be prepared to make a quick, permanent repair when they get stuck on the road.

One such experience more than offsets the small cost of the vulcanizer, and is the most convincing evidence of its convenience and dependability.

Why the Shaler Is Quicker and Easier

The Shaler Patch-&-Heat Unit is the secret. It is a little tin pan with a piece of raw rubber on the bottom and containing a disc of prepared solid fuel that gives just the right amount of heat to cure the patch.

To mend a puncture you clamp one of these Units over it, touch a match to the fuel, and wait 5 minutes. That's all there is to it. No gasoline, no shears no knife to cut a patch to fit—not even cement—needed to make a heat-vulcanized repair anywhere on the road.

There is no substitute for the Shaler because there is no substitute for Vulcanizing with Heat. Any repair man will tell you that.

Complete Outfit Costs Only $1.50

Slightly higher in Canada and far West.

Get yours today at any accessory dealer, garage or hardware store. They all carry the Shaler in stock.

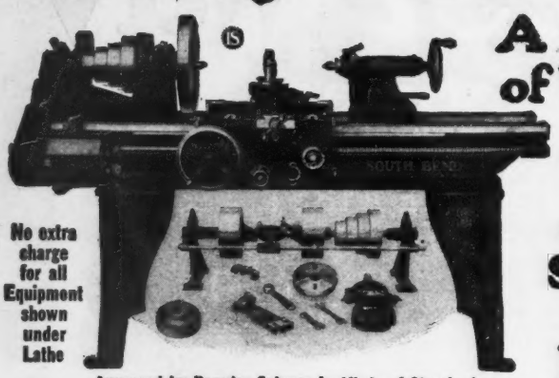
C. A. SHALER CO.

Executive Offices and Factory: **2100 Fourth Street, Waupun, Wisconsin**
Branch Factories: **Beeston, England, and Montreal, Canada**

SHALER
5 MINUTE VULCANIZER

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Easy! To Own



No extra charge for all Equipment shown under Lathe

Approved by Popular Science Institute of Standards

A LATHE of Your Own

GET OUR Easy Payment Plan on This 16" x 6' Quick Change Gear

South Bend Screw Cutting LATHE

Only $466 Complete—Other Lathes as Low as $197 on Terms

Our easy-payment plan enables you to use your South Bend Lathe while you are paying for it. You make a payment down, and the Lathe is shipped at once on 30 days' trial. Convenient monthly payments may be arranged for the balance. In this way the Lathe helps earn its own cost, and you secure the same high quality product used in America's leading shops.

32 Major Improvements—Increased Accuracy and Efficiency

The New South Bend Lathes embody 32 major improvements made in the last two years—all insuring extreme accuracy, efficiency, economy and convenience. More than 31,000 South Bend Lathes in use.

SOUTH BEND LATHE WORKS,
317 East Madison St., South Bend, Ind.
Gentlemen:
I would like your factory price and terms on a.....Lathe.
Please send Free Catalog.
Name.....
Address.....
.....

CATALOG FREE!

Showing 96 Styles—All Sizes

Let us send you a copy of this Free Book. Then you can select just the Lathe you need. Compare our money-saving prices and liberal terms with what others offer. Write or send coupon today.

South Bend Lathe Works, 317 EAST MADISON STREET SOUTH BEND, IND., U. S. A.

PRICES REDUCED

Only $3 Down

A Year to Pay

Yes, lowest prices on UNDERWOOD, REMINGTON, L. C. SMITH, ROYAL, and all standard makes on easiest terms ever offered. Re-manufactured like new by the famous "Young Process."

10 Days' Trial—5 Years Guarantee

Our liberal "direct from factory plan" saves half. You actually use the typewriter 10 days without obligation to buy. Let us prove we have the greatest typewriter bargains ever offered. Big saving.

Big Illustrated Catalog Free

This interesting valuable book explains fully how "Young Process of Re-Manufacturing" guarantees you highest quality, perfect service and satisfaction.

YOUNG TYPEWRITER CO. Est. 1911

Send Coupon Now

Young Typewriter Co., Dept. 1423
654 W. Randolph St., Chicago

Send me Free book and Special Reduced Prices. This does not obligate me in any way.

Name.....
Address.....
City.....State.....

FREE

140-page Book full of life-size ruled forms, each one completely filled in. The answer to problems of accounting and record keeping for any business or profession.

Send for this FREE Book today

John C. Moore Corporation
(*Established 1839*)
2189 Stone St., Rochester, N. Y.

MOORE'S LOOSE LEAF SYSTEMS
In Use In More Than 300,000 Offices

The Home Workshop

Discarded Flashlight Cells Serve as Radio A Battery

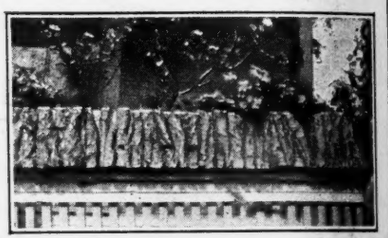
RADIO receiving sets equipped with 1½-volt tubes may be supplied with A-battery current from flashlight cells that have become too weak for their original purpose, but still retain enough "juice" to light small tubes. These discarded cells usually may be had for the asking from a friendly dealer.

Spring clips make contact with cells

In connecting these cells in parallel, I place them in a small box of three-ply veneer 4 by 2⅜ by 1½ in. The hinged lid is fitted inside with a ½-in. strip of spring brass 4 in. long, as shown. This connector extends ½ in. beyond the end of the lid, opposite the hinge.

A similar strip on the bottom of the box serves as the negative contact piece. Small binding posts are soldered to the ½-in. extensions so that the battery can be connected easily and quickly with the set.—GEORGE DEAN, Bloomington, Ind.

Slabs of Bark Decorate Porch-Rail Flower Boxes



TO CONCEAL the bareness and crudity of plain wooden porch-rail flower boxes, one home-owner cut slabs of bark from a fallen cottonwood tree and attached them to the boxes with shingle nails. In the fall, when the plants are taken indoors for the winter, the box will be emptied and stored in the basement until the following spring.—LOUREE OSBORN, Lincoln, Neb.

Paper Forms Wind Break and Spark Screen for Pipe

MEN who smoke a pipe out of doors find that when the wind blows hard the tobacco burns out quickly or causes dangerous sparks. Pipe caps are not always handy, but a simple wind protector can be made from a scrap of paper wrapped about the bowl two or three times and twisted into a quill, as illustrated.

WHITE lead (in oil) mixed with whiting, which is a powder, makes a putty that dries hard and sticks fast.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

EVEREADY HOUR
EVERY TUESDAY AT 9 P. M.
For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations

WEAF	New York	WFI	Philadelphia
WJAR	Providence	WCAE	Pittsburgh
WEEI	Boston	WGR	Buffalo

Dry "B" Batteries are an economical, dependable and convenient source of plate current!

There's more life in Eveready Batteries

BUY Eveready "B" Batteries and you get electricity in its surest, safest and most compact form. They reduce your operating expense. New developments in the Union Carbide and Carbon Research Laboratories, Inc., have been converted into new manufacturing processes in the Eveready factories. Good as they always have been, Eveready "B" Batteries are much better today.

The Eveready achievement of giving you more hours of "B" Battery service for less money has cut the cost of running receivers in half, and in some cases the new Evereadys make "B" Battery expense only a third of what it used to be.

There is an Eveready Radio Battery for every radio use.

Manufactured and guaranteed by
NATIONAL CARBON COMPANY, INC.
Headquarters for Radio Battery Information
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY
Radio Batteries
—they last longer

No. 7111. 1½-volt Dry Cell "A" Battery for all dry cell tubes

No. 772. 45-volt Large Vertical Price $3.75

No. 770. 45-volt Extra Large Vertical for heavy duty Price $4.75

No. 771. 4½-volt "C" Battery improves quality, saves "B" Batteries Price 60c

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

$25.00 in PRIZES See top of page 8 in front of book for details.

Deafness

Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Relaxed or Sunken Drums, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums

"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable.

Write *today* for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.

WILSON EAR DRUM CO., Incorporated
736 Inter-Southern Bldg. LOUISVILLE, KY.

AGENTS EARN A GOOD INCOME

You can sell Premier Knife Sharpeners to housewives, restaurants, stores, etc. 9 out of 10 will buy. Sells for 50c. *Write today for attractive offer.* PREMIER MFG. CO. Dept. 9 Detroit, Mich.

LARGE PROFIT for you

MOVIES IN YOUR HOME

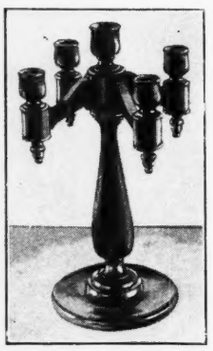
Our marvellous, practical MOVIE MACHINES sell as low as $3.75 postpaid and use same size film as big theatres. We also have wonderful films at lowest prices—with a new film exchange service. DON'T MISS THIS! *Write NOW for free catalogue*
PARAMOUNT MFG. CO.
Dept. PS 7 Boston, Mass.

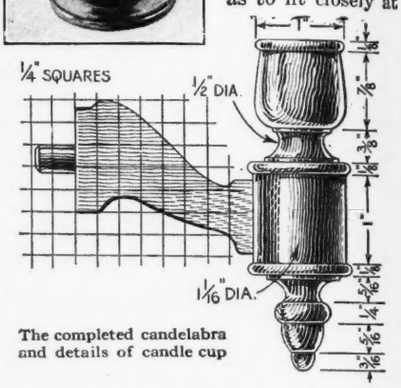
The Home Workshop

Small Ornamental Candelabra Turned from Wood

IF YOU have access to a wood-turning lathe, you will find it easy to make the candelabra shown in the accompanying illustrations.

The base, which is 5½ in. in diameter, is turned on the faceplate, and has a ¾-in. hole to take the upright. The standard is turned from a piece 1¾ in. square. The four outside candle cups are turned as detailed, and fastened to the standard by means of brackets cut with a coping-saw. The ends of the brackets are made slightly concave so as to fit closely at





The completed candelabra and details of candle cup

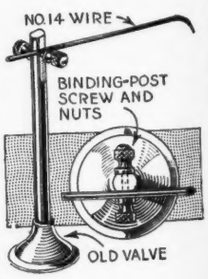
the joints and one small dowel is used in each glued joint.

The hole for the center candle is ¾ in. in diameter; for the others, 11/16 in. If five candles of the same size are used, the four outer ones can be trimmed a little to fit. It is possible to use a ¾-in. bit for all the holes if the four outer candle-holders are made a little heavier than shown.

All the turned pieces are polished with shellac in the lathe after a filler has been applied and allowed to dry. Felt is glued on the under side of the base.—E. E.

Surface Gage Made Cheaply from Auto-Engine Valve

A DISCARDED valve from a Ford engine serves as the stand for the homemade surface gage illustrated. The two nuts and screw used for adjusting the gage wire are from a discarded dry cell, the cotter-pin hole in the stem being enlarged slightly in order to take the screw.—FRANK W. BENTLEY, JR.



A PIECE of garden hose split down one side makes a good protector for a drawknife when it is to be placed in a chest or drawer with other tools.—M. E. S.

Ⓘ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Fun indoors — *with a Radiola*

Good music, a glowing fire . . . *comfort!* Jokes, speeches, songs, dancing . . . *fun!* The best times of the winter, right at home, with a Radiola.

Everywhere — city, suburb, and far-away farm — Radiola III-a will bring in music and laughter — news and exciting new interests. It is low in cost — but big in performance, and with its four tubes it gets distance *on dry batteries.* It brings in programs from the country over, brings them in always clear — always *real!*

"There's a **Radiola** *for every purse"*

Radiola III-A. With four Radiotrons WD-11, headphones, and Radiola Loudspeaker. Complete except batteries and antenna, $90.

Radiola III. With two Radiotrons WD-11 and headphones. A great buy at . . $35.

You Can always Add: Radiola Balanced (push pull) Amplifier, with two Radiotrons WD-11, to make a four tube set out of Radiola III, ... $30.

RADIO CORPORATION OF AMERICA

Sales Offices: Suite No. 113
233 Broadway, New York
10 So. La Salle St., Chicago, Ill.
28 Geary St., San Francisco, Cal.

Radiolas manufactured and distributed in Canada by the Canadian General Electric Company, Limited, Toronto, and the Westinghouse Company, Limited, Hamilton, Ont.

RCA
This symbol of quality is your protection

Radiola

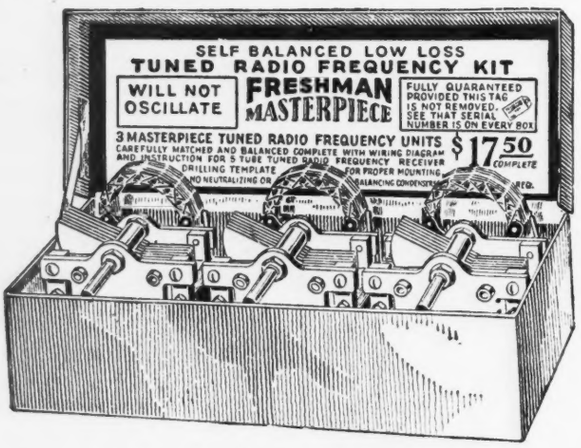
REG U.S. PAT OFF

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

FRESHMAN MASTERPIECE

It's Easy to Build

a five tube radio frequency receiver when you use the Freshman Masterpiece Kit


SELF BALANCED LOW LOSS
TUNED RADIO FREQUENCY KIT
WILL NOT OSCILLATE
FRESHMAN MASTERPIECE
FULLY GUARANTEED PROVIDED THIS TAG IS NOT REMOVED. SEE THAT SERIAL NUMBER IS ON EVERY BOX
3 MASTERPIECE TUNED RADIO FREQUENCY UNITS CAREFULLY MATCHED AND BALANCED COMPLETE WITH WIRING DIAGRAM AND INSTRUCTION FOR 5 TUBE TUNED RADIO FREQUENCY RECEIVER
$17.50 COMPLETE
DRILLING TEMPLATE
FOR PROPER MOUNTING
NO NEUTRALIZING OR
BALANCING CONDENSERS REQ.

NO Neutralizing OR Balancing Condensers Required

when you build with this kit to produce a radio frequency receiver that will bring in even the most distant stations with the volume and clarity of locals. So selective that stations can be brought in day after day at the same dial settings. A set that will be the equal, if not the superior, to any 5 tube receiver on the market, and what's more, *it's extremely simple to operate.*

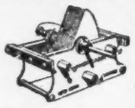
Kit consists of 3 Masterpiece Tuned Radio Frequency Units carefully matched and balanced. Complete with wiring diagram and instructions for building any 5 tube tuned radio frequency receiver and also drilling template for proper mounting, **$17.50**

Each and every Freshman Masterpiece Coil bears a serial number and Trademark—our guarantee of electrical and mechanical perfection. For your protection demand only the genuine.

At your dealers, otherwise send purchase price and you will be supplied without further charge. Ⓢ

Chas. Freshman Co. Inc.
Radio Receivers and Parts
FRESHMAN BUILDING
240-248 WEST 40TH ST.-NEW YORK N.Y.

AMBASSADOR
Low Loss Products



Master Tuning Coil
Perfectly Balanced Head Phone
Low Loss Condenser

High grade, standard radio products that will increase the efficiency of any set and add to the satisfaction of the user. Ambassador Low Loss Products have long been the choice of particular fans. See them—compare them, and you will choose them too.

At all good dealers
Write for FREE circuit diagrams in which Ambassador products can be used.
AMBASSADOR SALES COMPANY
108 Greenwich St., New York
426 W. Madison St., Chicago
Ⓢ

AMAZING ELECTRIC IRON
Burns 821 Hours Without Getting Red Hot

New York.—A new kind of Electric Iron just invented ends the possibilities of burned, scorched clothes and dangerous house fires. This new iron positively can't start a fire—can't burn clothes—and uses ¼ less electricity. It has a safety Fuse that automatically turns the current off when the iron gets too hot and a warning glow that tells when the current is on or off.

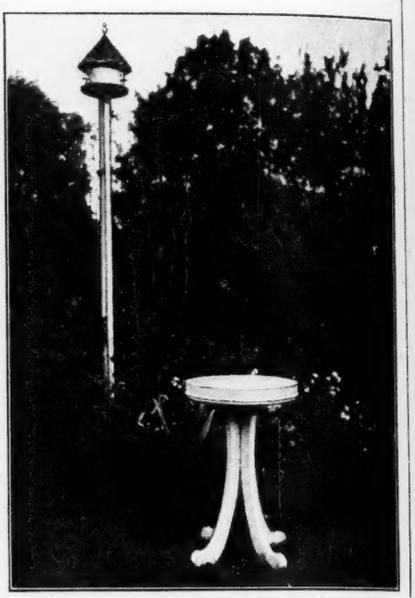
The new Electric Iron—called the Brite-Spot—sells quickly wherever shown and offers salesmen a rare opportunity to make big money in full or spare time. To interest men and women who desire to demonstrate the Brite-Spot in their own home town and in that way build up a business of their own, the manufacturers are making a Big Special Offer. Address The Diana Studios, Dept. 543, 334 Fifth Avenue, New York City.

The Home Workshop

How to Build an Ornamental Bird House and Bath

BIRDS bring animation and life into a garden. They always can be attracted if provisions are made for their safety and comfort.

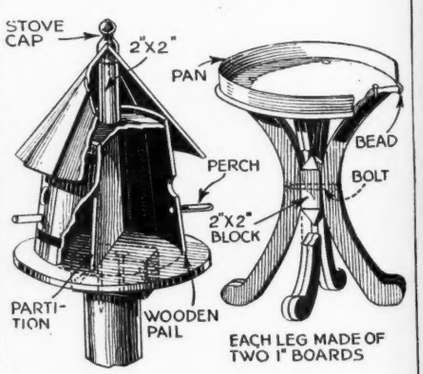
The bird house illustrated is made by mounting a wooden pail on a pole and providing a roof. The platform projects



Garden bird bath on wooden support and bird house for wrens made of an old pail

2 in. beyond the wall. Partitions for two or three compartments may be made, and this is desirable if it is expected to attract wrens. The reason is that a pair of wrens like to raise the second brood of the season in a new apartment.

The bird bath consists of a pan cut from an old metal container and mounted on a



How simple it is to build the bird house and bath is indicated in these details

wooden stand with legs of the shape illustrated. For strength, each leg is composed of two thicknesses of 1-in. boards nailed together with the grain of one piece running at a slightly different angle from that of the other.—C. L. MELLER, Fargo, N. D.

THE best methods of building an auto speedster will appear in the April issue.

Ⓢ **This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS.** **See page 33.**

A Special Offer!

An opportunity for radio fans to save money in buying Celoron Panels and Vulcawood Cabinets

WE are making this special introductory offer to make new friends for our products and for the dealers who sell them.

Celoron is the standard insulating material among leading radio manufacturers and it is the choice of nearly a million radio fans. It is made by the oldest and largest manufacturer of vulcanized fibre and laminated technical materials in the world. In spite of these facts there are many fans who never have had an opportunity to see and use this popular insulating material. Many others have never heard of the Vulcawood Cabinet—the new cabinet of bakelite.

For a limited time, we offer you the privilege of buying these standard, well-known parts direct from our factory—at special introductory prices. Orders will be accepted subject to the conditions outlined below.

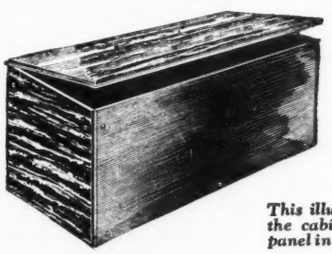
This offer expires on April 30, 1925.

Your money back if not satisfied

If your dealer does not stock and carry these parts, you may select a cabinet, and the panel to fit it, at the special introductory prices quoted.

In return for this privilege we ask you to send us your dealer's name and the names of three of your friends who are radio fans.

We shall refund your money without a whimper if you are not entirely satisfied with the goods when received. No red tape—no delay—no questions asked.



This illustration shows the cabinet—with the panel in place.

NEW VULCAWOOD CABINET

the only bakelite cabinet made

This new bakelite cabinet insulates your entire set. It protects your delicate instruments from dust and dirt. It eliminates troublesome body capacity effects.

The Vulcawood Cabinet is grained and colored to match beautiful hand rubbed mahogany. It comes packed flat and is easy to set up.

Vulcawood Cabinet Prices

Sizes	*List Prices*	*Special Prices*
(1) 7 x 7 x 10	$7.95	$4.50
(2) 7 x 7 x 12	8.10	4.50
(3) 7 x 7 x 14	8.10	4.50
(4) 7 x 7 x 18	9.40	4.50
(5) 7 x 7 x 21	10.40	6.50
(6) 7 x 7 x 24	10.40	6.50
(7) 7 x 7 x 26	10.55	6.50
(8) 7 x 7 x 30	11.15	6.50

DIAMOND STATE FIBRE COMPANY

Bridgeport, Pa., and Chicago, Ill.

Branches in Principal Cities **Toronto, Canada—London, England**

CELORON RADIO PANELS

universally endorsed by radio experts

Celoron will help you get better results from your radio hook-up. It will give your instruments thorough, leak-proof insulation. It will help you get greater distance, greater volume.

A Celoron Panel will not soften with heat or deteriorate with age as do rubber and composition panels. It retains its beauty and its insulating properties indefinitely.

Celoron Panel Prices

Sizes	*List Prices*	*Special Prices*
(1) 7 x 10 x 3/16	$1.09	$1.00
(2) 7 x 12 x 3/16	1.31	1.00
(3) 7 x 14 x 3/16	1.53	1.00
(4) 7 x 18 x 3/16	2.95	1.00
(5) 7 x 21 x 3/16	3.45	2.00
(6) 7 x 24 x 3/16	3.94	2.00
(7) 7 x 26 x 3/16	4.25	2.00
(8) 7 x 30 x 3/16	4.92	2.00

If your dealer does not carry Celoron, order by mail

In ordering please follow these simple directions:

1. Indicate on the coupon the size of the panel and the size of the cabinet you want.
2. Print in your name and address carefully.
3. Clip out the coupon and attach it to a plain sheet of white paper.
4. Mark on the white sheet the name and address of your dealer and the names and addresses of three friends who are radio fans.
5. Attach your check or money order to the white sheet.
6. Mail all papers to the Diamond State Fibre Co., Bridgeport, Penn.

DIAMOND STATE FIBRE COMPANY,
Dept. 101
Bridgeport, Pennsylvania

Please send me prepaid the following items:

Celoron Panel Size No. . . . . Price $.....

Vulcawood Cabinet (without panel) Size No. Price $.....

Check attached $..... Total $.....

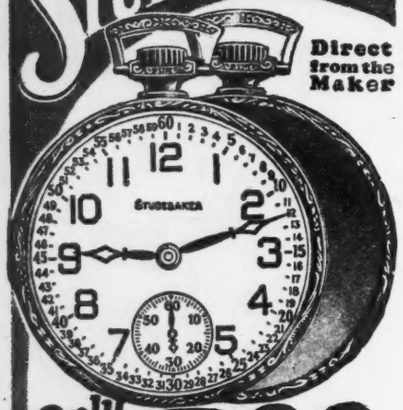
Name .....

Street .....

City ..... State .....

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

21 Jewel
STUDEBAKER
Direct from the Maker



Only $1.00 DOWN

America's greatest Watch value sent you for only $1.00 down! The balance in easy monthly payments. The famous 21-Jewel Studebaker Watch—

Insured For a Lifetime!

You may choose from 54 new Art Beauty Cases and 8 handsome dial designs. 8 adjustments *—to the second*—for heat, cold, isochronism and 5 positions. Sold *direct from the maker* at lowest prices ever named for equal quality. Mail coupon today for Free Book and Special Offer.

Watch Chain FREE
For a limited time, we are offering a beautiful Watch Chain FREE. Write now while this offer lasts.

WRITE FOR BOOK
Mail the Coupon

Send at once and get a copy of this book—FREE! See the newest, beautiful advance styles in Studebaker Art Beauty Cases and Dials. Read how you can buy a 21-Jewel Studebaker Insured Watch direct from the maker—save big money—and pay for it in easy monthly payments. Get Free Chain offer while it lasts. Mail coupon today.

STUDEBAKER WATCH CO.
Dept. J23 South Bend, Indiana
Canadian Address: Windsor, Ont.
Ask for Ladies' Bracelet Watch Folder

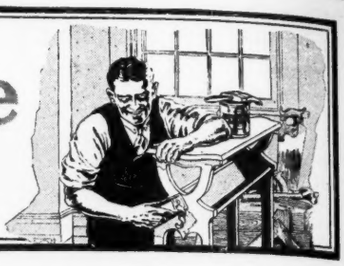
STUDEBAKER WATCH CO.
Dept. J23 South Bend, Indiana
Gentlemen: Please send me your Free Book of Advance Watch Styles and particulars of your $1.00 down offer.
If you live in Canada send your inquiry to Canadian Office, Windsor, Ontario
Name ....
Address....
City.... State....
☐ Check here for Ladies' Watch Folder. ☐ Check here for Jewelry Folder.

Easy to Draw Cartoons
When Shown in the RIGHT WAY

Some of the cleverest cartoonists and comic artists learned how to draw in their spare time by following **Cartoonist Evans' Simple and Easy to Learn Method** and are now MAKING GOOD MONEY. Send one of your drawings, and let Mr. Evans see if you have ability and receive the **Portfolio of Cartoons** and full details about the course. **It is not expensive.**

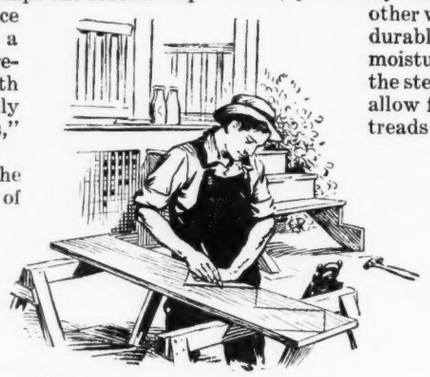
THE W. L. EVANS SCHOOL OF CARTOONING
825 Leader Building Cleveland, Ohio

The Shipshape Home



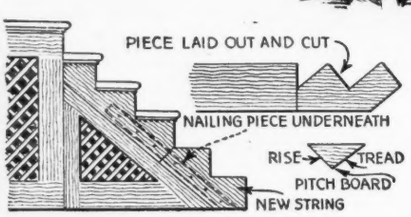
Repairing Porch Steps

WHEN the proper method is followed, the home worker can repair porch steps with very little difficulty. Usually only the first and perhaps the second step give way. To replace the step itself is a minor repair, but frequently one or both side pieces, technically known as "strings," need to be replaced.



First measure the height of the back of the step, which is known as the "rise," and the width of the step or tread, not including the nosing, or projecting overhang. Make a pattern of cardboard or thin wood from these dimensions, as illustrated. This is known as the "pitch board." It is well worth while to make such a pattern even for a small repair job.

Lay this pattern on a new board of the proper width and not less than 1⅛ in. thick, preferably white pine, cypress, or other wood that is relatively durable when exposed to moisture. Then mark out the steps as indicated and allow for a slight fall of the treads to run off the rain.



How the new "string" is laid out and used to patch old porch steps

Cut out the new piece of string neatly. Rip the board, if necessary, to make it exactly the same width as the old string.

Having removed the steps and risers at the bottom, place the new piece against the old and mark where the old is to be cut out. Now prop up that side of the steps and cut out the old string. Nail a 4- or 5-ft. length of rough lumber on the inside of the old string after cutting the bottom to fit on a flat stone, some brick, concrete, or whatever is used as a base for the steps.

Fasten in the new section of string with nails and replace the old steps and risers, if considered in good enough condition, or make new ones. If neatly done, this repair will not be noticeable after the new wood is painted.—A. E. ELLING.

Painting Wallboard

WALLBOARD, which is now used to such a large extent in making repairs around the home, usually is finished by painting. It takes paint especially well so that a good finish is insured if ordinary care is used in wielding the brush.

Most wallboard is primed and prepared for painting by the manufacturer. In case the wallboard is not primed, it is always necessary to coat it either with a thin varnish or a glue size.

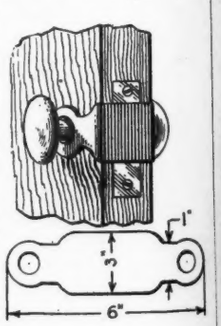
Do the painting, if possible, before the panel strips are nailed in place, unless the strips are to be the same color as the wallboard.

The preferred finish is usually two coats either of flat or full gloss paint, although one coat of dark paint may cover sufficiently. The first coat should be thinned with raw linseed oil and turpentine. After it is dry, fill all the holes and cracks with putty, colored to match. The final coat should be applied as it comes from the can.

For a still better result, a first coat of flat paint may be followed by one or two coats of enamel. The enamel may be left glossy or rubbed with a fine powdered pumice-stone and water or oil to a dull, smooth finish.

Sound Deadener

WHEN there is sickness in the home, the banging of doors can be prevented by the use of a deadening device similar to that found in some hospitals. A piece of rubber of the shape illustrated is cut from an old inner tube. One hole is slipped over the door knob and the rubber is stretched until the other hole can be passed over the opposite door knob.

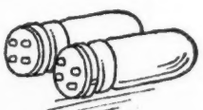


This prevents the doors being locked, but they will stay closed if shut tightly and no sound will be made, not even the click of the spring catch.—EDGAR WELCH, Oklahoma City, Okla.

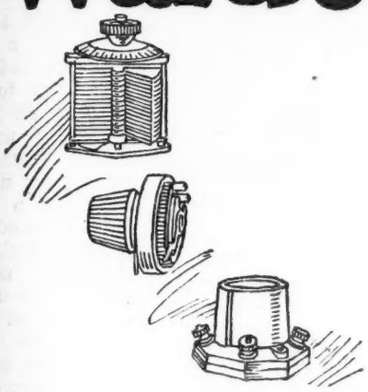
This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Radio Headquarters

Why not buy your set or parts at Radio Headquarters? Only tested and approved radio equipment is sold. Every set sold by us is guaranteed to give satisfactory results.



Ward's Radio Catalogue



The best Radio Experts made this catalogue—men who devote their entire time to Radio—who are up to the minute with everything new, who tell you the best hook-ups, who have selected for you the best tested parts, who have chosen the best sets—so simple that you yourself can easily install them—so reliable that we guarantee them to give satisfaction.

Write for your copy of this Catalogue. See for yourself the low prices. Buy your radio at Radio Headquarters.

Our 53 Year Old Guarantee

Ward's has dealt with the American people for 53 years under a definite guarantee of "Money back if you are not satisfied." All our Radio sets are guaranteed to give satisfactory results and back of this guarantee is a proven reliability that for 53 years has not been questioned. Address our house nearest you. Dept. 5-R.

ESTABLISHED 1872

Montgomery Ward & Co.

The Oldest Mail Order House is Today the Most Progressive

Chicago Kansas City St. Paul Portland, Ore. Oakland, Calif. Ft. Worth

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

BUILDING TRADES NEED TRAINED MEN

Thousands of good positions at good salaries

THE building trades are still booming. Trained men are in demand at good salaries. Government experts estimate that billions of dollars will be spent for construction this year.

Today the most vital need of this great building program is men—*trained men*—men who can step right in and do the skilled work that building construction requires.

There is a simple, easy, practical way by which you can prepare for a better position, at a bigger salary. You can do it right at home, in spare time, no matter where you live, through the International Correspondence Schools.

A recent investigation of 13,928 students enrolled in I. C. S. Building Trades Courses showed that 1921 had become Architects; 246 had become Designers; 494 had become Chief Draftsmen; 2827 had become Draftsmen; 1845 had become Contractors; 211 had become Assistant Foremen; 4030 had become Foremen; 2354 had become Superintendents.

You, too, can have the position you want in the work you like best; an income that will give you and your family the home, the comforts, the luxuries you would like them to have.

Mail the Coupon for Free Booklet

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7643-D, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

TECHNICAL AND INDUSTRIAL COURSES

☐ Architect	☐ Electrical Engineering
☐ Architects' Blue Prints	☐ Electric Lighting
☐ Contractor and Builder	☐ Mechanical Engineer
☐ Architectural Draftsman	☐ Mechanical Draftsman
☐ Concrete Builder	☐ Machine Shop Practice
☐ Structural Engineer	☐ Railroad Positions
☐ Chemistry ☐ Pharmacy	☐ Gas Engine Operating
☐ Automobile Work	☐ Civil Engineer
☐ Airplane Engines	☐ Surveying and Mapping
☐ Agriculture and Poultry	☐ Metallurgy ☐ Mining
☐ Mathematics	☐ Steam Engineering ☐ Radio

BUSINESS TRAINING COURSES

☐ Salesmanship	☐ Business Management
☐ Advertising	☐ Industrial Management
☐ Better Letters	☐ Personnel Organization
☐ Show Card Lettering	☐ Traffic Management
☐ Stenography and Typing	☐ Business Law
☐ Business English	☐ Banking and Banking Law
☐ Civil Service	☐ Accountancy (including C.P.A.)
☐ Railway Mail Clerk	☐ Nicholson Cost Accounting
☐ Common School Subjects	☐ Bookkeeping
☐ High School Subjects	☐ Private Secretary
☐ Illustrating	☐ Spanish ☐ French

Name.....
Street 3-6-24
Address.....
City.....State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada.

Be a Diamond Expert!

FREE! GENUINE Diamonds if you enroll at once

Do you know that of two diamonds of equal size one may be worth a hundred times as much as the other? Who can distinguish them but an expert? My short, easy course will make you a diamond expert in a few months! Get it before you buy your next diamond—it will save you money!

$5000 to $15,000 a Year!

Be a diamond expert and go into business for yourself on only $25 or $50 capital! We will show you how! Be a diamond expert and become independent. The diamond business is a gentleman's business. Success in any other line of business means $5000 a year—success in the diamond business means up to $15,000 a year! Millions of dollars are paid out every year for diamonds! Jewelry houses everywhere need diamond experts—always pay high for expert opinions. Diamond experts are rare!

WRITE FOR FREE BOOKLET

"Paying Diamond Knowledge" will be sent to you absolutely FREE! Contains new and amazing and startling facts about diamonds.

WRITE NOW!

CODINGTON SCHOOL OF DIAMONDS
3457 Sunnyside Dept. 202 Chicago, Ill.

Better Shop Methods

Kinks that Have Saved My Time

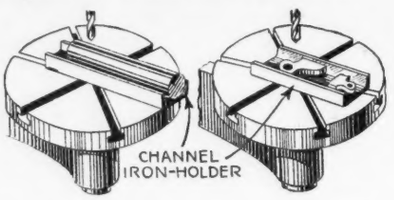
By E. C. Fellows

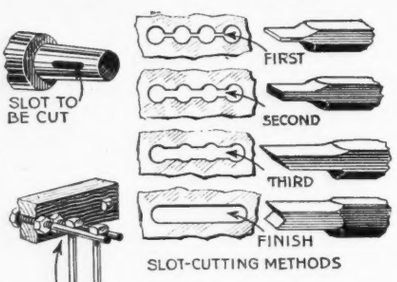
"ED, YOU must have worked on the Pyramids!" remarked Joe, as he stopped to watch me put the finishing touches on a slot in a boring bar.

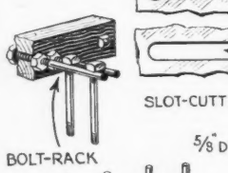
"What makes you think so?"

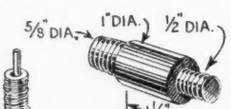
"Oh, because you're always up to some kind of a stunt that's all hand work," said Joe.

"Well, perhaps this is an antique way of doing a slotting job, but when you get a little practice, it's about as quick and easy as any other way. A narrow slot like this is a mean job on a milling machine, and I'd much rather finish it up with my set of four chisels. You have to drill holes to get the stock out, anyway."





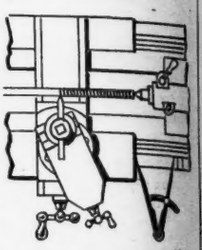




The chisels I use are illustrated above.

Short pieces of channel iron of different sizes help to speed up work on the drill press. For holding shafts and other round work these irons are about as good as a V block where extreme accuracy is not a factor. They also are handy for holding many small, odd-shaped pieces. If desired, they can be planed on the bottom inside and out, and along the top edges for holding round work parallel.

Speaking of saving effort, there's nothing that takes more of a man's time than looking up bolts, nuts, and washers. I have solved this problem to a large extent by arranging racks as illustrated. This is a job for the helper or one of the apprentices.



Divider marks new starting point

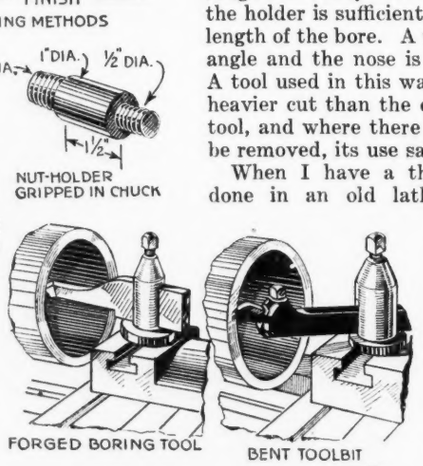
For facing and chamfering nuts I have on hand several sizes of nut arbors similar to that shown. A thread is cut on each end so that one arbor will serve for nuts of two different sizes. These arbors are held in the chuck by gripping the central portion.

I save a lot of time and valuable tool steel in lathe work by making up special forms of tool bits for lathe toolholders. Of course, there are instances where forged tools are preferable. When making a forged boring tool I prefer the shape shown; the feature being that the taper comes on top where there is most room and adds to the stiffness of the tool.

FOR boring small holes I make up toolbits as needed for the toolholder. In the illustration below are shown a boring tool and one for outside threading.

When boring large bushings and in similar work I find the toolholder makes a rough-and-ready tool where the length of the holder is sufficient to reach the entire length of the bore. A toolbit is bent to an angle and the nose is ground for boring. A tool used in this way will take a much heavier cut than the conventional boring tool, and where there is a lot of metal to be removed, its use saves time.

When I have a threading job to be done in an old lathe without a dial indicator and the lathe has to be stopped for any reason, I use a divider to mark a point from which to make a new start, instead of running back to the first mark, which is the usual way. I set the divider to any number of equal inches, according to the lead screw and the number of threads to be cut, as shown at the top of this column, and run the carriage back to it.



Tools for slotting, boring, and threading; work-holding fixtures, and handy shop racks

FEW shops have extension handles for taps to get into inaccessible places, as in certain auto-repair work. Often holes of this kind can be tapped for oversize bolts or retapped by finding a hexagon nut that can be driven over the square end of the tap and then using a socket speed wrench on the nut. — C. CARPENTER.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

When Trouble Comes at Night Far from Help

YOUR headlights bore a hole in the dark to the road sign and you read the bad news.

Your fingers nervously explore in the gloom for your tools, they fumble at a stubborn nut, the wrench slips—it doesn't fit. You try another and it won't reach in. You work, tug and wonder if you'll get going. At night—on a lonely road like this—you will doubly appreciate the speed and efficiency of Snap-On Wrenches in helping you out of your trouble.

Don't be at the mercy of hit or miss tools any longer. It's too costly. Go to the nearest Snap-On Dealer now—ask to see the Set of Snap-On Wrenches scientifically selected by our engineers for your particular make of car. The Snap-On interchangeable principle gives you—in a mere handful of high grade steel units—wrench combinations that will reach, fit and easily turn every nut and bolt.

Genuine Snap-Ons are for sale by most good Hardware Dealers.

Learn how to cut operating costs of your car in half—mail coupon for free illustrated folder.

SNAP-ON WRENCH CO.

Manufacturers—Milwaukee

Snap-on

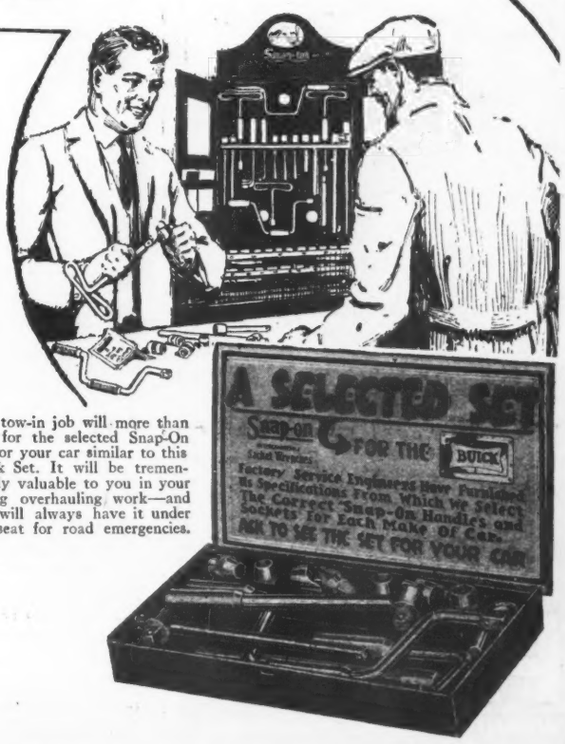
INTERCHANGEABLE

Socket Wrenches

Look for the name—without it no wrench is a genuine Snap-On

Dealers

Install this Snap-On Display Cabinet and supply the complete socket wrench needs of car owners and all other wrench users in your community. Remarkably low shelf investment, quick turnover. Write for details of our Sales Plan.


A SELECTED SET
Snap-on FOR THE BUICK
Factory Service Engineers Have Furnished Us Specifications From Which We Select The Correct Snap-On Handles and Sockets for Each Make of Car.
ASK TO SEE THE SET FOR YOUR CAR

One tow-in job will more than pay for the selected Snap-On Set for your car similar to this Buick Set. It will be tremendously valuable to you in your spring overhauling work—and you will always have it under the seat for road emergencies.

MOTOR TOOL SPECIALTY CO., ***Distributors***
14 E. Jackson Blvd., Chicago, Ill.

Gentlemen:
Please send me full particulars about Snap-On Kit

for.....car. (If interested in Master Mechanic's Kit for all cars check here)

.....

I buy tools from.....

Name.....

Address.....

IS This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

THEY SAY OF THE PFANSTIEHL MODEL 7

"People *now* want trouble-proof service and purity of tone. The new Pfanstiehl . . . gives a clear, natural tone at any distance. . . . There is no distortion, however great the amplification. . . . It comes in like velvet. . . . Two stages of audio amplification—low ratio, of course, to give perfect quality, with all the volume desired."

Pfanstiehl amplifies with Thordarsons

THEY SAY OF THE HOWARD NEUTRODYNE

"It brings in distant stations distinctly. It has natural tone qualities. It has remarkable volume."

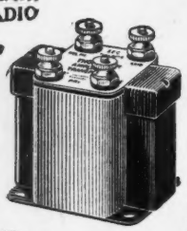
Howard amplifies with Thordarsons

THEY SAY OF THE RADIODYNE

"When you own a Radiodyne you can hear singers' voices and orchestral harmonies faithfully reproduced thru the loud speaker . . . so clear and distinct that you lose nothing."

Radiodyne Amplifies wi h Thordarsons

ZENITH KENNEDY Radiodyne CL THERMIODYNE ULTRADYNE MURDOCK AZARKA Pfanstiehl MICHIGAN Deresnadyne MALONE LEMON MASTER RADIO ROYAL Howard Pathé HARMONY AUDIOLA GLOBE SAAL AND MANY OTHERS



When Better Transformers Can Be Bought— *They Will Be Thordarsons!*

TONE quali'y! Clear, natural reception! Even volume over the entire musical range! That is what the public demands today. And is getting in the finer sets—equipped with Thordarsons for *musical* amplification.

Leading set makers continually test and compare transformers. They use *more* Thordarsons than all competitive makes combined—which answers the transformer question. If *you* want really fine amplification, simply follow their lead: *build or replace with Thordarsons!* All stores can now supply you. Accept no substitutes. If your dealer is sold out, you may order from us by mentioning his name. Interesting bulletins on amplification mailed free. Write.

THORDARSON ELECTRIC MANUFACTURING CO.

Transformer specialists since 1895

WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS

Chicago, U.S.A.

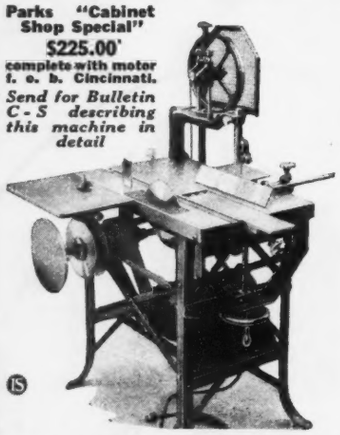
Unconditionally Guaranteed

THORDARSON Super AMPLIFYING TRANSFORMERS

Standard on the majority of quality sets

TYPES AND PRICES: Thordarson "Super" Audio Frequency Transformers are now to be had in three ratios: 2-1, $5. 3½-1, $4. 6-1, $4.50. Thordarson Power Amplifying Transformers are $13 the pair. Thordarson Interstage Power Amplifying Transformer, $8. Write for latest hook-up bulletins—*free!*

Parks "Cabinet Shop Special" $225.00 complete with motor f. o. b. Cincinnati. *Send for Bulletin C-S describing this machine in detail*



The biggest little woodworker ever built!

You'll want this sensational Parks combination woodworker right away for your shop—includes 8-inch rip and cross-cut saw, 4-inch jointer, band-saw, borer, shaper, sander, and universal motor. Complete with lathe attachment only $225.00. First-class Parks angle-steel construction, all joints electric-welded. Steel table-top. The newest thing in small shop equipment. Guaranteed 10 years.

The Parks Ball Bearing Machine Company
1547 Knowlton St., Cincinnati, O.
Canadian Factory: 200 Notre Dame East, Montreal, Can.

PARKS
WOODWORKING MACHINES

Earns Big Money

J. Gordon Says $4000 Profit In 2 Months!

Making and Selling Popcorn Crispettes

GEORGE ALEXANDER, of Pennsylvania, **made $3,000.00 in 4 months.** Ira Shook, Flint, took in **$365.75** in one day. Bram bought one outfit, then 10 more within a year. Mrs. Lane, Pittsburg, sold **8000 packages** in one day. J. R. Bert, Ala., wrote, "only thing I ever bought that equaled advertisement." Patillo, Ocala, writes: "Crispettes all you claim and then some." Kellog, **$700 ahead** end of second week.

WE START YOU IN BUSINESS!

Furnish secret formulas, raw material, and equipment. Small capital required; no experience needed.

Build Business of Your Own

No limit to the sale of Crispettes. Everybody likes them. It's a delicious food confection made with or without sugar. Write for facts about a business that will make you independent. Start in your town.

Profit $1000 Month Easily Possible

Send postal for illustrated book of facts It contains enthusiastic letters from others—shows their places of business, tells how and when to start, and all information needed. Free. Write now!

Long-Eakins Co. 347 High St. Springfield, O.

Better Shop Methods

$4 Awards Offered for Photos of Ingenious Tools

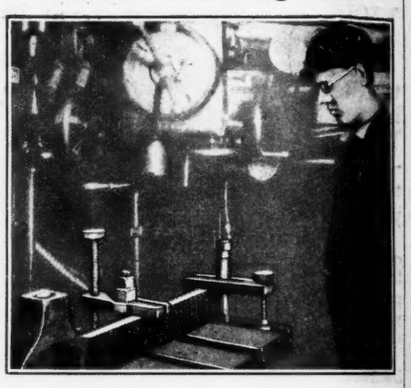
HARRY M. CORNWELL, of Cumberland, Md., a reader of POPULAR SCIENCE MONTHLY who contributed the design of a drill-press clamp shown below, writes:

"I am a drill-press operator myself and have had two of these clamps in every-day service for the past year. They are a vast improvement over the old method of clamping, especially where there is such a variety of work as around a railroad shop."

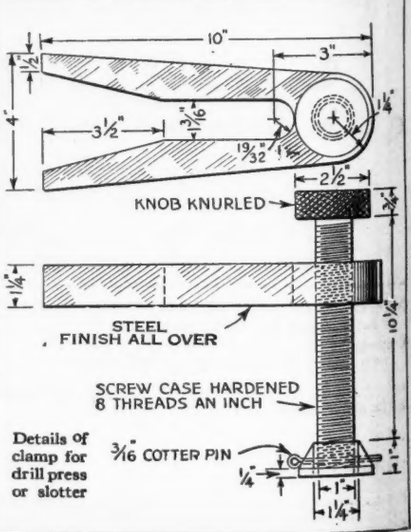
If you are a mechanic, no doubt you have made at some time or other an especially useful or unusual tool or fixture to accomplish work that could not be done so easily with your regular tools or with any tool you could go out and buy.

If you have made such a tool, send a clear photograph of it, with a brief description of its construction and purpose, to the Editor, Better Shop Methods Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York. For each photograph available for publication, POPULAR SCIENCE MONTHLY will pay $4.

Special Clamps Provide Quick Method of Holding Work

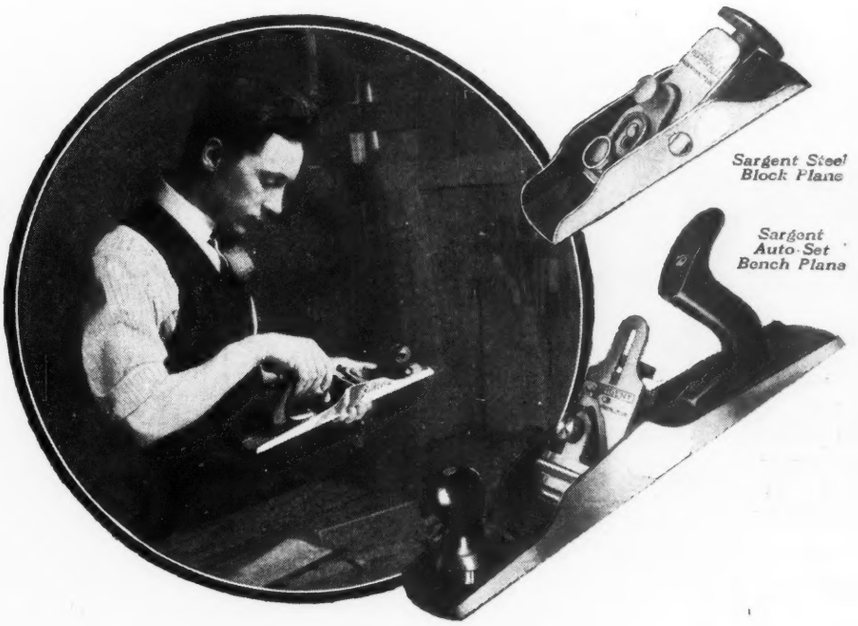


THE clamp illustrated saves the time of the machine operator in fastening down a job on a drill press or slotter. It does away with the use of blocking.—HARRY M. CORNWELL, Cumberland, Md.



SARGENT

PLANES



The beauty of Sargent Planes is not in their looks alone

SARGENT Planes are beautiful tools—in design, materials and fineness of construction and finish. But the beauty of them that's most appealing is in the way they do their work. Always smooth and clean-cutting, with never a murmur! And "murmur" isn't simply a figure of speech.

As you undoubtedly know, the important part of any plane is the cutter, and the next thing is to make sure that it will not chatter or murmur when going across or against the grain.

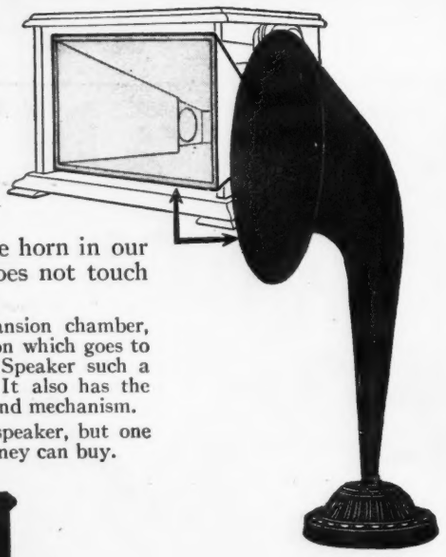
Here are two of the advantages you get in Sargent Planes: 1—a cutter of finest chromium steel, tough, wear-resisting, edge-holding. 2—absolute rigidity when the cutter is in place.

Of course there are other points that will interest you—points that make these two moderate-priced planes most desirable for every home and school work-bench. See Sargent Planes at your hardware dealer's and write us for booklet, which gives detailed information about them.

SARGENT & COMPANY, *Mfrs.*, 50 Water Street, New Haven, Conn.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

It Has the Full Sweet Resonance of Our Upright Horn



The outer end, or bell, of the horn in our cabinet model loud speaker does not touch anything.

This, together with a long expansion chamber, gives it the same freedom of vibration which goes to make the Bristol horn type Loud Speaker such a resonant, sweet-toned instrument. It also has the same high-grade electromagnetic sound mechanism.

Not only is it a handsome loud speaker, but one worthy of the best radio set that money can buy.

Model C
$30.00

Model S
$25.00

There are five Bristol Loud Speakers, priced from $12.50 to $30.00. If not at your dealer's, write for Bulletin No. 3020-CA.

The Bristol Company
Waterbury, Conn.

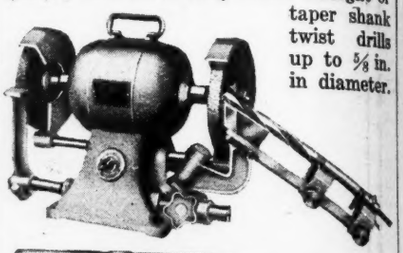
BRISTOL AUDIOPHONE Loud Speaker

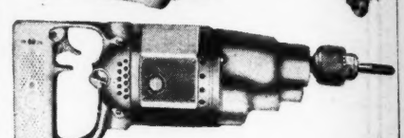
Better Shop Methods

New Tools Aid in Grinding Drills and in Tapping

THE twist-drill grinder and the electric tapper shown below are tools recently developed to supplement the electric hand drill, the many uses for which were described in the article, "What You Can Do with the Aid of a Portable Electric Drill," in this department last month.

The twist-drill grinder will sharpen quickly and accurately either straight or taper shank twist drills up to 5/8 in. in diameter.





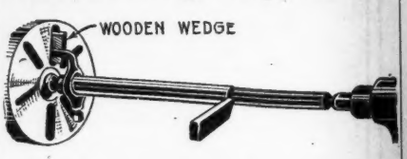
Electrically driven bench or pedestal grinder for sharpening twist drills and portable tapper with automatic reverse

The drill is fed to the dish grinding wheel by means of a micrometer screw feed.

Heretofore many garages, service stations, and small machine shops have had to depend upon free-hand methods of grinding drills. The new machine therefore has a wide field for service, especially as the necessity for grinding twist drills to the correct angle, with proper clearance and with both cutting lips exactly the same length, is universally recognized.

The electric tapper differs from an electric drill in that the gearcase is so designed that the tap turns at a speed of 350 r. p. m. By a slight backward pull of the machine, the tap chuck is reversed automatically and the tap backed out of the threaded hole at twice the speed with which it is driven in. It will tap holes in steel up to 1/4 in.; in cast iron up to 3/8 in., and in brass or aluminum up to 5/8 in.

Wooden Wedge Stops Chatter



HOW to stop chattering is a problem that confronts every machinist at some time or other when turning shafts or other round work between centers. When the piece is not being supported by a steady rest or a follow rest, the chatter almost always can be prevented by wedging the dog in the driving slot of the faceplate, provided the piece is not unusually long. A wooden wedge may be used or even a small piece of old belting or cotton waste.

Factory to Rider

Saves $10 to $25 on the Ranger Bicycle you select from 44 Styles, colors and sizes. Delivered free on approval express prepaid for 30 Days' Free Trial.

$5 a Month if desired. Possession and use at once on our liberal Monthly payment plan. Bicycles $21.50 and up.

Tires lamps, wheels, equipment at half usual prices. Write for marvelous new prices, wonderful 30 day trial offer and terms.

Mead CYCLE COMPANY DEPT. A250 CHICAGO Write us today for free catalog

$150 to $300 MONTHLY PROFIT

1 Day Battery Charging

Brings trade and big profits. Only $35 cash brings complete equipment for One Day battery charging. Small monthly payments. Free trial or moneyback guarantee. Write for Free Bulletin 20.

HOBART BROS. CO., Box P3, Troy, Ohio.

HB ONE DAY BATTERY CHARGING

wonderful startling!

The NEW UNCLE SAM MASTER TUNING COIL

THE COIL WITHOUT LOSSES

1—Wound on moulded hard rubber.
2—Increases volume 50% to 250%, also selectivity, over old type.
3—Eliminates all adhesives.
4—Laboratory tests prove it is the only Coil worthy of the name Lowloss.

FREE! Ask your dealer or send us four cents in stamps for wiring diagrams of circuits in which this remarkable coil can be used.

UNCLE SAM ELECTRIC CO.
209 E. Sixth St. Plainfield, N. J.

"Old Town Canoes"

Where'er the smiling stream may beckon

GET an "Old Town" this summer and realize the joy of a truly fine canoe. "Old Towns" are beautiful canoes. They are patterned after real Indian models.

Invest in an "Old Town" today and you will receive dividends in happiness for years to come. "Old Town Canoes" are low in price. $64 up. From dealer or factory.

The 1925 catalog shows all models in full colors. It is free. Write for your copy today. OLD TOWN CANOE CO., 1593 Main Street, Old Town, Maine, U. S. A.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Better Shop Methods

Old Bill Says—

THERE'S a lot more satisfaction in owning your own tools than borrowing from others.

The next time a perpetual borrower comes to you and says: "Lend me this or that," see if you can extract a promise from him to buy the tool for himself not later than next pay-day.

Old Bill, machine-shop foreman

Never mark the size on a tool that is made in the shop unless that size is absolutely right. Some one else may pick it up without measuring it and spoil a piece of work.

Oil your machine each morning before starting up.

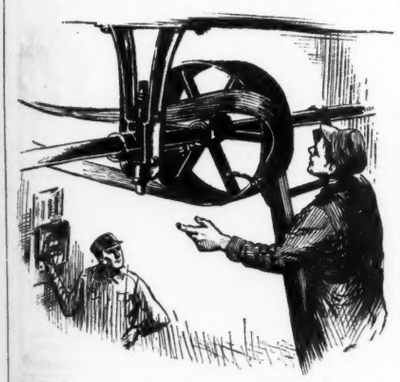
Never place files, heavy wrenches and tools, or rough castings on the ways of the lathe, not even an old lathe.

It is dangerous to run emery wheels with the guard removed; if you value your head, keep the guards in place.

A good mechanic is never satisfied with anything less than his best.

Try to help the other fellow as much as you can and make his job easier for him—some day you may be glad of his help.

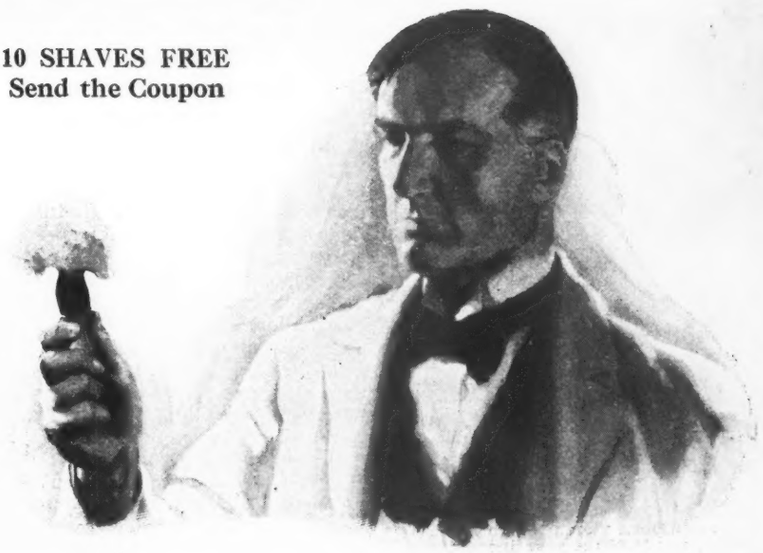
Safe Method of Putting Belt on Line-Shaft Pulley



IN MANY places it is difficult to put on long line-shaft belts after they have been removed for shortening or when they have run off for any reason. It is dangerous to try to do this while standing on a ladder.

A safe and easy method is to tie the belt on the under side of the pulley as shown. Have another man stand at the starting box or clutch shifter and when all is ready let him apply the power slowly. The belt will creep up over the rim of the pulley. When the rope reaches the top, signal to stop and then untie the knot.

10 SHAVES FREE
Send the Coupon



We must prove

The claims made for this unique Shaving Cream before you buy it

—please accept a test

By Chief Chemist

GENTLEMEN:

You hear men talking about Palmolive Shaving Cream. Any man who uses it will spend 30 minutes, any time, urging its advantages.

Palmolive has quickly become leader in its field. Only great merit, you'll agree, can account for so dramatic a success.

Now we ask you the favor of a trial.

5 New Delights

Over 130 formulas were tested and discarded before we offered it to you. It embodies the 4 things 1000 men told us they wanted most in a shaving cream, *plus* a 5th—strong bubbles, the supreme requisite of all.

Won't you let us send you 10 shaves free?

5 ***delights***

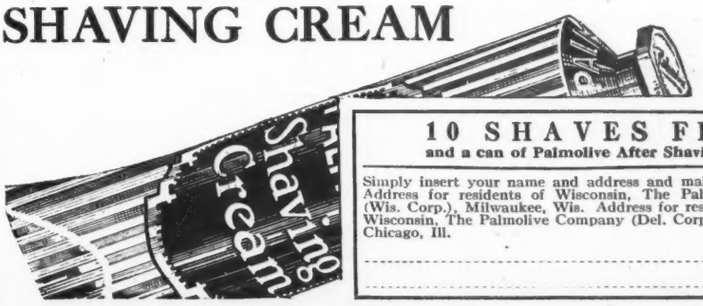
1—Multiplies itself in lather 250 times.
2—Softens the beard in one minute.
3—Maintains its creamy fullness 10 minutes on the face.
4—Strong bubbles hold the hairs erect for cutting.
5—Fine after-effects, due to palm and olive oil content.

Now in justice to yourself and us, make the test. Simply mail the coupon.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh. Sample free with the tube of shaving Cream. Clip coupon now.

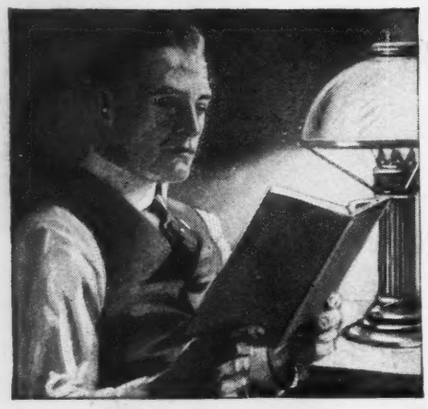
THE PALMOLIVE COMPANY (Del. Corp.), Chicago, Ill.

PALMOLIVE SHAVING CREAM



10 SHAVES FREE
and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B 955. Address for residents of Wisconsin, The Palmolive Company (Wis. Corp.), Milwaukee, Wis. Address for residents other than Wisconsin, The Palmolive Company (Del. Corp.), 3702 Iron St., Chicago, Ill.



$95 an Hour!

"Every hour I spent on my I. C. S. Course has been worth $95 to me! My position, my $5,000 a year income, my home, my family's happiness—I owe it all to my spare-time training with the International Correspondence Schools!"

Every mail brings letters from some of the thousands of I. C. S. students telling of promotions or increases in salary as the rewards of spare-time study.

What are you doing with the hours after supper? Can you afford to let them slip by unimproved when you can easily make them mean so much? One hour a day spent with the I. C. S. will prepare you for the position you want in the work you like best. Yes, it will! Put it up to us to prove it. Mark and mail this coupon now!

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7642-D, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

BUSINESS TRAINING COURSES

☐ Business Management	☐ Salesmanship
☐ Industrial Management	☐ Advertising
☐ Personnel Organization	☐ Better Letters
☐ Traffic Management	☐ Show Card Lettering
☐ Business Law	☐ Stenography and Typing
☐ Banking and Banking Law	☐ Business English
☐ Accountancy (including C.P.A.)	☐ Civil Service
☐ Nicholson Cost Accounting	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Common School Subjects
☐ Private Secretary	☐ High School Subjects
☐ Spanish ☐ French	☐ Illustrating

TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineering	☐ Architect
☐ Electric Lighting	☐ Architects' Blue Prints
☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
☐ Metallurgy ☐ Mining	☐ Agriculture and Poultry
☐ Steam Engineering ☐ Radio	☐ Mathematics

Name.....
Street Address..... 3-6-24
City..... State.....
Occupation.....
Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

NEW LOW PRICES!

Combination Ranges $59.80 Up

Get manufacturer's prices. Save 1-4 to 1-2 on stoves, ranges, furnaces, and household goods during the greatest sale in our 25 years' history. Cash or easy payments—terms as low as $3 monthly. Money-back guarantee. 24-hour shipments. 30 days' trial in your home. 530,000 customers endorse Kalamazoo quality.

Kalamazoo Stove Co., Mfrs. 781 Rochester Ave. Kalamazoo, Mich.

Send for FREE BOOK

"A Kalamazoo Direct to You"

Better Shop Methods

Winning a Shop Race

(Continued from page 100)

drill. The base of the machine had a hole to guide the lower end of the bar. He found some clamps so that he could fasten the wheel in place. He turned the pulley so that one of its spokes was against the column.

"To make sure that it does not turn and spoil my setting," he said by way of explanation.

A machinist came up with some calipers and measured the bar.

"I've been making a bushing for the table arm," he said; "have it ready for you in about two minutes now."

LATON got a long bar about ⅜ in. square. It looked like key steel. He bent one end of it to a hook shape and put the other end in the cutter hole of the boring bar. He swung it around to center the wheel by the rim. Then he turned the hook up out of the way so that he could see if the rim was at right angles with the axis of the bar. He was just clamping the wheel firmly in place, all trued up, when the bushing was brought over to him. Old Bill also came along.

"There is so much to take out of that hole that I thought you could make faster time if we had some support closer to the cutter, especially since the spindle is somewhat worn," Old Bill said. "That's why I had this bushing made for the table arm."

Old Bill turned to Johnson. "Laton has this job going well now, so why don't you look about the shop, and see how some of the other things are done," he suggested. "If you will see some of the hard things that we do, maybe you will understand how it is that some jobs take longer to do than you think they ought."

Old Bill and Johnson started through the shop.

They had not gone very far when they saw several men gathered around a lathe in attentive attitudes. One of them was standing on the carriage with a red hot bushing in a pair of tongs. Another had a flatter. A third had a sledge ready.

THERE was a shaft in the lathe and the men were putting a bushing on the end of it. It went on very nicely, and almost before Johnson could say anything, they were cooling the bushing with water.

"Another trick to save money for our customers," Old Bill explained. "This is a spindle that runs very fast. It wore down so much on this bearing right at the end that they were about to throw it away and have me make a new one. There was nothing else the matter with it, only this bearing got so small that it kept on running hot. The pulley is right next to the bearing, and the belt is very tight. Instead of throwing the shaft away, we make a steel bushing and shrink it on the shaft, which then is finished to size.

"This is for a planing mill in about the same fix that you are. It can't work until we get this fixed up. So you see we *have* to know how to do things in a hurry."

(Continued on page 151)

The Children's hour is Radio hour

Cunningham RADIO TUBES

are sensitive to the most delicate tone shading. Their use in your receiving set insures clear, well-rounded reception.

Combined with this supersensitiveness is a rugged durability. Cunningham Tubes serve long and well.

Since 1915
Standard for All Sets

Types C301, C299, C300, C11, C12
In the orange and blue carton

Patent Notice: *Cunningham tubes are covered by patents dated 2-18-08, 2-18-12, 12-30-13, 10-23-17, 10-23-17, and others issued and pending.*

E. J. Cunningham Inc.

HOME OFFICE
182 SECOND ST.
SAN FRANCISCO CHICAGO NEW YORK

BIG NOVELTY BARGAIN! 10 Cts.

THROW YOUR VOICE
Into a trunk, under the bed or anywhere. Lots of Fun fooling the Teacher, Policeman or Friends. Barrels of Fun.

THE VENTRILO,
a little instrument, fits in the mouth out of sight, used with above for Bird Calls, etc. Sent with full instructions; anyone can use it, NEVER FAILS. Also a 32 PAGE BOOK ON VENTRILOQUISM. Formula for Secret Writing, 12 Money Making Secrets and the marvelous

NOVELTY X-RAY WONDER
With it you can apparently see the bones in your fingers, lead in pencil, etc; lots of fun with this outfit. Also 10 Big Magic Tricks Free with every order. All the above Novelties by prepaid mail for 10¢

VENTRILO COMPANY
Dept. 756 Norwalk, Conn.
LARGEST and OLDEST Mail Order House in Connecticut.

LATEST WHOLESALE RADIO CATALOG FREE
Simply send name TODAY for big 48-page catalog of latest radio goods at Wholesale.
Live dealers and agents wanted.
STANDARD RADIO CO., 104 East 13th, Kansas City, Mo.

"LIGHTING FIXTURES"
Ready to hang.
Direct from the manufacturer.
Completely wired including glassware.
Send for Catalogue No. 26
(Just off the press)
Special proposition to Dealers
ERIE FIXTURE SUPPLY CO.
Desk A. Erie, Pa.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Better Shop Methods

Winning a Shop Race

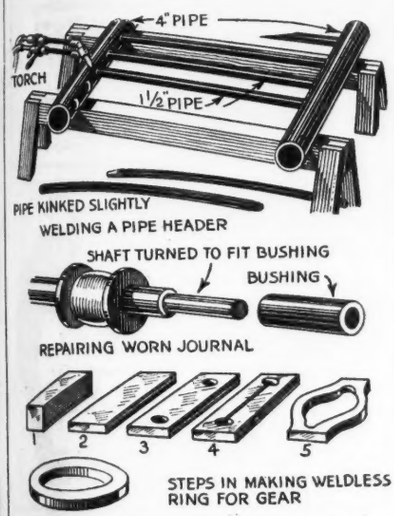
(Continued from page 150)

The two went on between the rows of lathes and drills and shapers. On the way through the welding shop, Old Bill stopped to look at a header being made.

"Making it up with welded joints gives a much stronger and more lasting job," he said. "This is for an ice plant, and would have to have three screwed joints for each one of these connections. They are hard to make tight, and the threads almost always rust through before the pipe. By welding it all together in one solid piece we get a much better job."

"But what is he bending that pipe for?" Johnson asked.

"To allow for the shrinkage of the welds," Old Bill replied. "If he did not



Avoiding shrinkage strains in welding pipe, and other repair methods used by Old Bill

do that, the welds would be strained when they cooled, and might leak. But by kinking each of these pipes just a little, it can straighten out and compensate for any excessive shrinkage strain. The bends are so slight that they will hardly be noticed when the job is all done. In fact, the welder is so good that he knows just exactly how much to bend to make them straighten out when they are cool."

They passed through the welding shop to the blacksmith shop. The blacksmith was apparently splitting a heavy piece of steel bar. Old Bill pointed to it.

"There is something that you will be interested in," he said. "Perhaps you noticed a gear come in with most of the teeth broken out? We have that gear in the lathe now, turning off all the teeth. We'll put a steel ring on and then cut new teeth in the steel part. Of course these teeth will be stronger than the cast-iron ones, which will make it a better wheel than it was before. In making a ring for this sort of job, we make it without any welds, so that there is no possibility of a weak place anywhere. For the smaller rings we use steel plate and cut it out with the cutting torch, but for one this large we have to forge a ring. We start with a chunk of steel about 4 in. square

(Continued on page 152)

MAGNAVOX Radio

ONE hand on ONE dial for *Tuning in!*

Magnavox Receiving Sets

TRF-5 (as illustrated) encased in carved mahogany cabinet; price includes M4 Reproducer . . $125.00

TRF-50 in carved mahogany period cabinet with dust-proof doors and built-in Magnavox Reproducer $150.00

Semi-dynamic Reproducer

M4—the most efficient unit ever designed to operate without external battery, $25.00

Electro-dynamic Reproducer

The original radio reproducer, famous throughout the world. With Volume Control.

R3, $35.00
R2, $50.00

MAGNAVOX

3R

EVEN though the Magnavox single dial Station Selector has displaced the "old style" complicated tuning arrangements, this remarkable feature *alone* would not have merited the praise which every owner gives his Magnavox Set.

It is by its sheer *musical quality*, in addition to its unusual simplicity, that the Magnavox 5-tube tuned radio frequency circuit retains the user's lasting admiration.

As pioneers in the design and manufacture of radio reproducers, Magnavox engineers were thoroughly equipped to master the problem of beautiful tone.

If you already own a receiving set, a Magnavox Reproducer will wonderfully enhance its daily usefulness for family and friends.

Magnavox Radio Products are carried by reliable dealers. Illustrated booklet on request

THE MAGNAVOX COMPANY, Oakland, Cal.

New York:	*Chicago:*	*San Francisco:*
350 West 31st St.	162 N. State St.	274 Brannan St.

Canadian Distributors: Perkins Electric Limited
Toronto, Montreal, Winnipeg

Tool Cases

for Machinists, Carpenters and Tool Makers; none better; thirty styles. Quartered oak and metal covered. Ask for booklet.

"Built for Service"

The Pillied Lumber Co., Swanton, Ohio

SENSATIONAL SALE

GUARANTEED TYPEWRITERS

Limited quantity fully guaranteed standard make typewriters. **5 Days Free Trial.** Lowest prices ever offered. Some at $45.35. Easy payments as low as $3 monthly. Send today for **FREE booklet** of Valuable Typewriter Information and Special Sale Bulletin.

Smith Typewriter Sales Co.
321-360 E. Grand Ave., Chicago, Ill.

I made $180 my first week

Approved by Underwriters

Any MAN can sell them

"And am able to average over $100 PER WEEK. Could do more only I do not put in much over half time. Personally I think it is the easiest sold article I ever handled as it has merit and is a necessity," says L.R. Graham, Illinois. A. H. Robey of W.Va. made over $500 in one month, Frank DePries has been with us six years—averages over $150 a week. Hundreds of our men making $60, $75, $100 a week. We need more men to fill unoccupied territory. Hundreds of prospects makes selling easy—garages, schools, stores, factories, shops, farms, homes, auto and truck owners, hospitals. Single sales bring big commissions. Largest concern of kind in world. Write quick about this position.

THE FYR-FYTER CO., 649 Fyr-Fyter Bldg., Dayton, O.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Big Money
and a Barrel of Fun

First-Class Saxophonists make big money, and the work is easy and pleasant. You might easily become a wizard like Tom Brown or Ross Gorman, or a great record-maker like Clyde Doerr or Bennie Krueger or Jos. Smith. $100 to $500 weekly is not unusual for such musicians to earn.

Talk About Fun!

There is always a good time for the Saxophone player. It's the ideal instrument for social entertainment. It is a key to social popularity. At parties, everywhere, the Saxophone player is the center of attraction.

Easy to Play-Easy to Pay

The Saxophone is the easiest of all instruments to play. You don't have to "study" it as you do other instruments. There's no practice drudgery. You don't have to be "talented".

3 LESSONS SENT FREE with the instrument start you. In a week you can play popular airs.

Besides being so easy to play - we make it very easy to pay for one of these Buescher Saxophones with our simple plan of deferred payments. Play and earn while you pay.

Free Saxophone Book

- Very interesting. Tells all about the various Buescher Saxophones, with pictures of the famous professionals and orchestras. Send coupon for a copy. Mention any other instrument in which you may be interested. 155

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
480 Buescher Block Elkhart, Ind.

Buescher Band Instrument Co.,
480 Buescher Block, Elkhart, Ind.
Gentlemen:
I am interested in the instrument checked below:
Saxophone...Cornet...Trombone...Trumpet..
(Mention any other instrument interested in)
Name.....
Street Address.....
Town.....State.....

Better Shop Methods

Winning a Shop Race

(Continued from page 151)

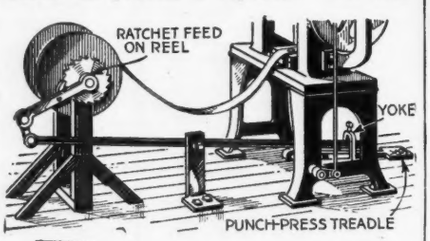
and long enough to weigh the same as the finished ring. Then we flatten it down to near the finished thickness, punch a hole near each end, and split the part between. The split is then opened out until the piece is ring shaped, and the blacksmith draws the metal out to get the required diameter. That makes a much better job than welding, and doesn't take much longer."

The pulley was ready by this time. Laton was taking it off the machine when Old Bill and his guest got back to the machine shop.

Old Bill stretched his neck, readjusted his hat and looked at his watch. It was eleven o'clock. The pulley would be running by night. So would the woodworking spindle, and a number of smaller items, each one of them "the most important rush job in the shop."

Automatic Feed Saves Time in Punching Thin Metal Stock

WHEN punching small pieces from metal ribbon that is wound on a reel, the operator usually unwinds some of the stock on the floor, and then proceeds to punch it until used up, after which the process is repeated. On thin



Each stroke of the press automatically turns the reel of thin metal ribbon

stock, this occasionally results in a tangle, with loss of time and waste of material.

Stock of this kind can be fed automatically by the method illustrated. The shaft that supports the reel carries a ratchet and pawl, connected by a lever with the press pedal. The yoke carried on the pedal is slotted to permit movement of the lever within it. The top of the yoke carries a setscrew by which the movement of the reel is adjusted.

Every time the pedal is depressed, the reel is advanced a certain amount. By permitting the stock to sag toward the floor, between the reel and the press, it is kept from loosening on the reel.—R. H. KASPER, Philadelphia, Pa.

SMALL pieces that are made of machinery steel can be casehardened quickly by applying cyanide directly to the piece when hot. Draw the piece out of the fire and sprinkle the cyanide over it or on the point to be hardened, using a long-handled spoon or a piece of flat iron. Replace in the fire and allow the cyanide to soak in. The operation may be repeated several times, according to the depth of penetration desired. Then plunge the piece in cold water.

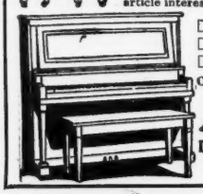
JUST 17c a Day Pays for this Beautiful Chair

Tapestry or Velour

Over 1000 other bargains. Furniture, Rugs, Lamps, Silver, China, Blankets, Stoves, etc. **Save Big Money** at our Factory-to-Family prices. Pay as little as $3 down; up to a year and a half to pay balance. Get all your Furnishings at once—pay as you use. Thousands buying this new way.

Big Catalog FREE

New Spring "*Larkin Book of Better Homes.*" Shows everything for parlor, porch, dining-room, bedroom, kitchen. **Bargain Prices** on famous Symphonola Phonographs. Also Symphonic Pianos, Player-Pianos in genuine Mahogany, Walnut, Fumed Oak. Free trial. Up to 4 years to pay. Satisfaction or money back. Check below article interested in.



☐ **Home Furnishings**
☐ **Pianos or Players**
☐ **Phonographs**

Cut out this adv.—write TO-DAY for FREE Book.

Larkin Co Inc.
Dept. 340, BUFFALO, N. Y.
Peoria, Ill. Chicago, Ill.

"DON'T SHOUT"

"I hear you. I can hear now as well as anybody. 'HOW?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The Morley Phone for the **DEAF**

is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.

THE MORLEY CO., Dept. 797, 10 S. 18th Street, Philadelphia

AGENTS—Bring Home the Bacon!

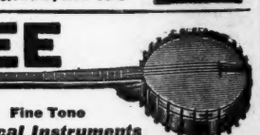
with Stuart's Stain Remover. Removes iron rust, mildew, ink, medicine, grass and fruit stains. Bleaches clothes, cleans straw hats. Every home, every store, every office is a prospect and agents are making

$8 to $10 a Day

This is part of our line of over 200 household specialties that are making other men and women independent. Some good territory open. Write at once for Outfit offer and Free Sample.

C. H. STUART & CO.
868 Lake St., Newark, New York

FREE



Fine Tone $20 Musical Instruments

We have a wonderful new copyrighted system of teaching note music by mail! To first pupils in each locality we will give free a fine superb Violin, Tenor Banjo, Ukulele, Hawaiian-Guitar, Banjo, Mandolin, Banjo-Ukulele, Banjo-Mandolin, Cornet or Banjo-Guitar absolutely free. Also teach Piano and Organ. Very small charge for lessons only. Four lessons will teach you several pieces. Over 100,000 successful players. We guarantee success or no charge. Complete outfit free. Write today. Dept. 250. No obligation.

Slingerland School of Music, 1815 Orchard St., Chicago, Ill.

AGENTS 500% PROFIT

GOLD & SILVER S SIGN LETTERS

GENUINE GOLD LEAF LETTERS

Guaranteed to Never Tarnish

Anyone can put them on stores and office windows. Enormous demand, large profits. Paul Clark says: Smallest day $28.70. R.L. Reel made $920 in two months. Write today for free sample and liberal offer to general agents.

METALLIC LETTER CO. 433-E N. Clark, Chicago

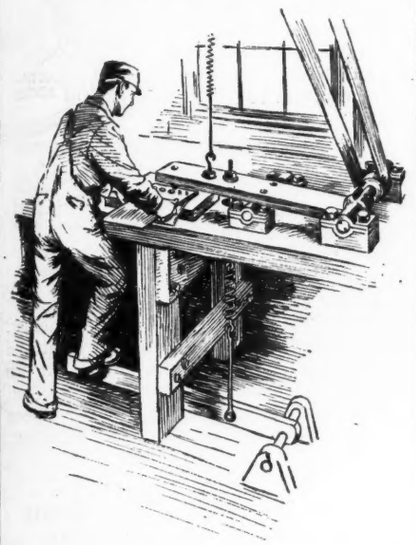
Better Shop Methods

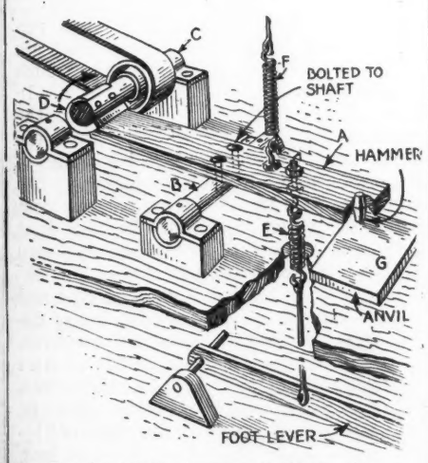
Bench Riveting Machine Speeds Production of Small Work

By H. E. Barber

BUILT right on the bench and run by a belt from the line shaft, this sturdy little riveting machine speeds up all kinds of small riveting. It will rivet over the heads of long, slender rivets without bending them at a speed of 2000 or more strokes a minute.

Dimensions are not given, as the machine may be built of any size most suitable for the kind of work to be handled. The hammer is attached by a taper fit in



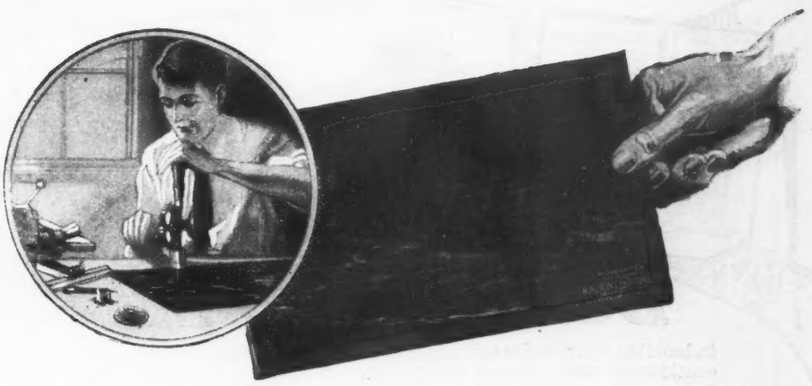


Pressing the foot lever causes the cam *D* to vibrate the hammer rapidly and forcefully

the end of the bar, *A*, which is bolted to shaft *B*. Shaft *C* has a cam *D* riveted to its circumference.

The cam turns continuously, but does not actuate the hammer bar because of the tension of the spring *F*. When the work is on the anvil *G*, the foot lever is pressed to operate the hammer.

The power of the hammer is derived from spring *E*. For fast work the pulley should be large enough to give the cam shaft a speed of from 2000 to 3000 revolutions a minute. The four bearings may be ordinary cast Babbitt bearings or even wooden blocks with Babbitt linings.



Just use ordinary tools on this panel— *built to order for radio*

YOU don't need special tools to do a good job on a Radion Panel. Just the usual tools found around any house will give you clean-cut, workmanlike results. You need not have the slightest fear of chipping.

Radion is the easy material to cut, drill, and saw. It was developed to order by our engineers to meet the demands of radio set builders. There is nothing quite like it for real results.

Highest rating as radio-frequency insulation

Authoritative laboratory tests give Radion the highest rating as radio-frequency insulation. That means that losses from surface leakage and dielectric absorption are exceptionally low. And low losses mean clearer reception, more volume and more distance.

You can see that Radion is different by looking at the finish. But that high-polished, satin-like surface is not for beauty alone. It's useful, too. Moisture and dirt cannot gather to cause leakage and leakage noises.

Radion resists warping. It's strong. It's moisture proof. It comes in eighteen stock sizes and two kinds, Black and Mahoganite.

Better performance will make it worth your while to ask for Radion by name, and to look for the name on the envelope and the stamp on the panel. Radio dealers have the exact size you want for your set.

Send for booklet "Building Your Own Set"

Our new booklet, "Building Your Own Set," giving wiring diagrams, front and rear views, showing a new set with slanting panel, sets with the new Radion built-in horn, lists of parts and directions for building the most popular circuits — mailed for ten cents. Mail coupon today.

Other Radion Products

The same qualities of low-loss insulation and attractive appearance characterize Radion dials (to match panel), binding post panels, insulators, knobs, etc.—also the new Radion built-in horn.

AMERICAN HARD RUBBER COMPANY
Dept, F3. 11 Mercer St., New York City
Chicago Office: Conway Building
Pacific Coast Agent: Goodyear Rubber Co., San Francisco—Portland

RADION
The Supreme Insulation
Ⓘ PANELS
Dials, Sockets, Binding Post Panels, etc.

AMERICAN HARD RUBBER COMPANY,
Dept. F3, 11 Mercer St., New York City
Please send me your new booklet, "Building Your Own Set," for which I enclose 10 cents (stamps or coin).
Name.....
Address.....
City..... State.....

Class Rings and Pins

CATALOG FREE

Largest Catalog Issued—FREE
Samples loaned class officers. Prices $.20 to $8.00 each. No order for class, society, club emblems too large or too small. Special designs made on request.

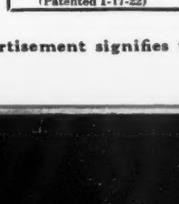
METAL ARTS CO., Inc., 7706 South Ave., Rochester, N. Y

RADIO SETS—AUTO BODIES

SEND FOR THE INTERNATIONAL CATALOG

Our net price list. Full line of Radio Sets; and auto bodies for Fords at *Wholesale Prices.* Save big money by buying Direct from Factory.

International Body Works, 914 W. Ohio St., Dept. 8, Chicago, Ill.



The Midget *"Five-in-One"* Slide Rule is a combination Mannheim, Polymetric, Log-Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Leather Case 50c extra. Sent C.O.D. if desired. Catalogue Free. GILSON SLIDE RULE CO., Niles, Mich.

(Patented 1-17-22)

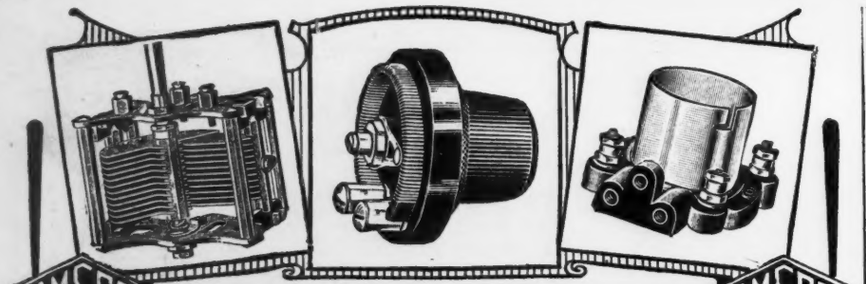
RECOVER IT YOURSELF

$3.85 AND UP Custom Made

Make your car look like new and save a big labor bill. We have been making top recoverings, side curtains and seat covers for 15 years. We have patterns for all makes, no model too old for us. Easy to apply, simple instructions given. Write for our big money saving catalogue with samples.

THE LIBERTY TOP & TIRE COMPANY, Dept. E-8, Cincinnati, Ohio

Ⓘ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



DON'T GAMBLE

in building your set by using inferior parts. You chance the loss of considerable time, money, and patience if the results aren't satisfactory. Be certain! Use only Amsco parts. Made by men who really know their business, they lead the field in all around performance.

Amsco Parts necessary for those who construct their own include the Low Loss Condenser, a laboratory instrument designed for perfection in set building. Also the Amsco Rheostat, for perfect filament control with all types of tubes and the Amsco Tube Socket with genuine Bakelite Base suitable for panel or table mounting.

At dealers everywhere. Free literature on request

AMSCO PRODUCTS, Inc., Broome and Lafayette Sts., New York (IS)

$25.00 in PRIZES

See top of page 10 in front of book for details

on the dot
It's as easy as placing your pencil point on a town on the map—this tuning in with Apex Vernier Dials.
They make logging a simple matter and "getting a station" positive. The ratio is 12 to 1. Sell in Royal Brass Finish for $2.00—Satin Silver Finish $2.50 DeLuxe Gold Plated (24k) $3.50. Applied to any shaft—quickly.
Apex 7-Tube Microdyne—Super-Heterodyne knock-down sets sell for $97.50. The Apex Super Five in a Walnut Cabinet is $95.00. See your better Radio Dealers.
Apex Electric Mfg. Co.
1414 W. 59th St.
CHICAGO
DEPT. 303
APEX VERNIER DIAL

The CHEMICAL FOUNDATION Incorporated

in order to "advance chemical and allied science and industry in the United States," offers its book

"Chemistry in Industry"

Price $1.00

(the net printing and mailing cost)

This book would ordinarily cost $5.00 but for three reasons: 1st, each of the twenty-one chapters is donated by its author, a recognized practical and scientific leader in his industry—2d, the edition is very large—3d, The Chemical Foundation was chartered for the advancement of chemical and allied science and industry in the United States, therefore can seek no profit.

The book covers these industries: **Abrasives, Alcohol, Coal and Coke, Cotton, Electricity, Fertilizers, Gas, Glass, Iron and Steel, Leather, Non-Ferrous Metallurgy, Packing House, Paper and Pulp, Perfumes and Flavors, Petroleum, Photography, Resin, Rubber and Textiles.**

This book is unique in contents and price and being written in popular language appeals to factory owners, managers, superintendents, buyers, foremen, workmen and to chemists and all students of Chemistry.

If the 362 page clothbound illustrated book does not meet your needs, return it and receive your $1.00.

Send $1.00 in check, money order or currency form to Dept. 9.

The Chemical Foundation Incorporated

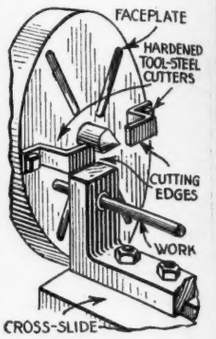
85 Beaver Street, New York

Better Shop Methods

Cutting Off Small Rods Rapidly in a Lathe

SHORT pins and other work made from small brass or steel stock can be cut off very rapidly in a lathe by the use of the simple device illustrated. Stock up to about 3/16 in. in diameter can be cut, and either two or four cutters can be used.

The cutters, which are tempered tool steel, are bolted to the faceplate. The faceplate itself serves as a stop for the work. The height of the cutters from the base to the top or cutting edge is equal to the length of the pieces to be cut.



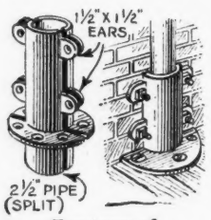
The cutters and rod guide

A cast-iron angle block is bolted to the compound and fitted with a tool-steel bushing to suit the size of the rod to be cut.

I have cut 3/16-in. rods with this device very quickly. By running the lathe at 500 revolutions a minute and having four cutters on the faceplate, I found it impossible to feed the rod fast enough to cut off four pieces at each revolution.—CHARLES KUGLER, Philadelphia, Pa.

Protecting Small Pipes from Damage by Shop Trucks

STEAM and water pipes that run through factory floors sometimes are seriously damaged by hand-operated lift trucks or even electric shop trucks. In our shop we finally worked out the method illustrated for protecting the pipes and their expensive covering of magnesia and sheet-iron lagging. The protector also keeps the mop water from following down the pipe to the next floor, provided the protector is painted with white lead when put down.



Two types of pipe guards

A 1-in. pipe and its covering of 85-per-cent magnesia measures about 2½ in. To make a protector for it, take a piece of 2½-in. pipe 14 in. long and have it cut in two on the planer with as narrow a tool as possible. Cut with a cutting torch out of ¼-in. boiler plate a flange that will fit the outside diameter of the pipe and be about 6 in. in outside diameter. Cut the flange in two on the planer or milling machine.

The flange and the four ears, which are approximately ¼ by 1½ by 1½ in., are welded on and then the drilling is done.

On pipes close to the wall one-half a protector will serve if long lag bolts are used, each with 2 nuts, 1 on either side of the ear.—A. J.

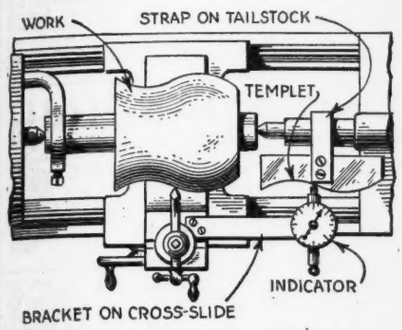
(IS) This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Better Shop Methods

Tailstock Templet for Turning Irregularly Shaped Work

IN SHOPS where irregular contours occasionally have to be turned, the method illustrated will save time.

A flat plate templet is made to correspond with the shape of the work and is attached to the tailstock by means of a special bracket strap clamped to the spindle with two bolts or cap screws. A



Top view showing how contour of templet is followed with a dial indicator

guide bracket made of a short piece of bar iron about ¾ by 2 in. is bolted to the cross slide. In the other end of this bracket is attached a dial test indicator. The indicator is adjusted so that the contact piece will bear against the templet.

Adjust the tool to the work and set the indicator dial to start at zero. The cut then is started in the usual manner and the templet followed by feed-in or -out while watching the indicator and keeping it steadily at zero.

Equally good results may be obtained in boring odd-shaped work by this method.—C. K.

Milling on a Drill Press

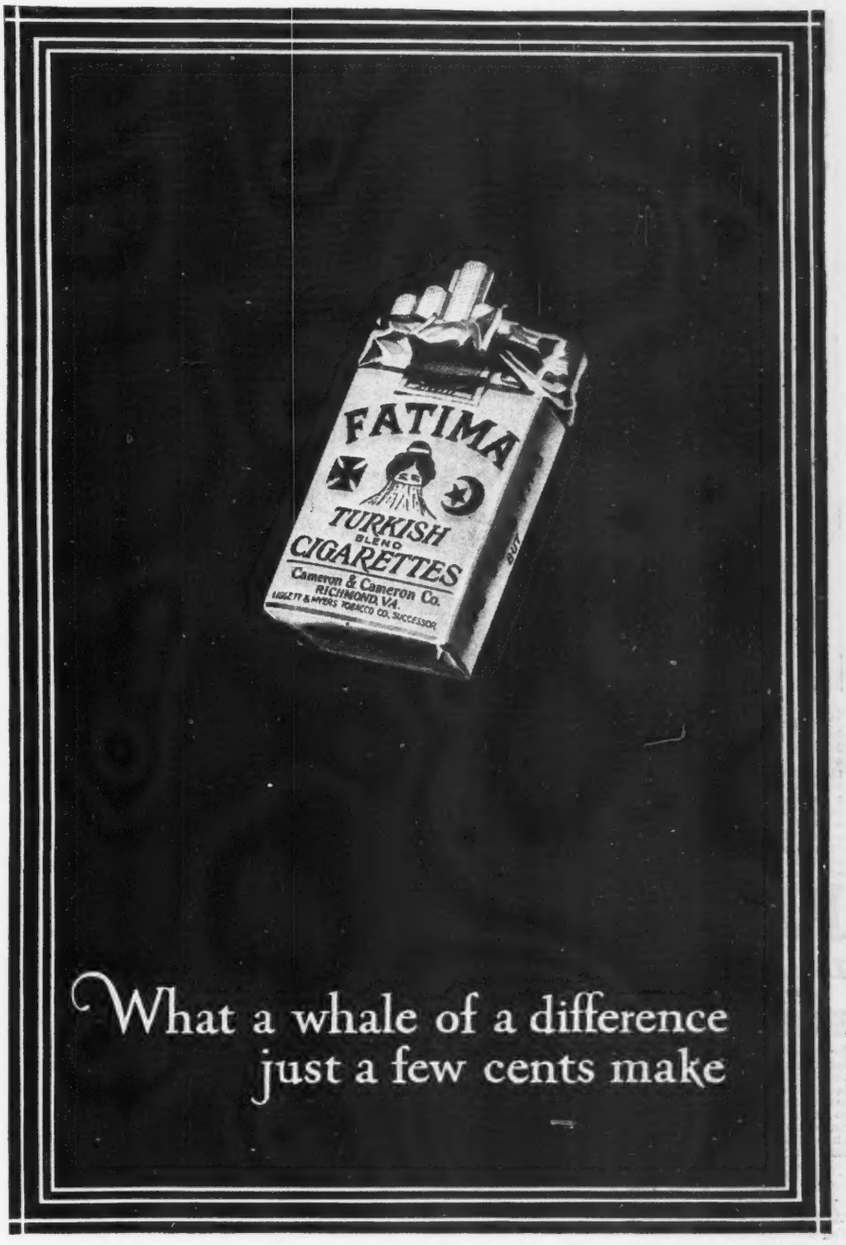
IN SMALL shops where the lack of machinery makes it a problem to handle the unusual jobs that are frequently encountered, it is possible to do some small milling jobs on the drill press.

The illustration demonstrates the milling of a groove. A flat parallel plate is clamped or bolted to the drill-press table and the work is set against this guide and clamped to the table loosely enough so that it will slip when tapped lightly with a hammer.

Hammer taps drive the work forward

A cutter is inserted in the spindle and set in the usual way for the depth of the cut. The work is tapped on one end to feed it to the cutter. The rotation of the mill tends to force the work against the guide, if the guide is placed correctly.

The same principle may be used in cutting curved patterns by pivoting the work on a bolt passing through the table so that the bolt will be at the center of the radius to be cut.—H. E. B.



What a whale of a difference just a few cents make

HAVE YOU AN INVENTION?
If so the WORLD PROGRESS will show you how to
Protect and Profit From Your Ideas
Sample copy free. One year's subscription 40c.
Send for free book,
"WHAT TO INVENT"
containing Suggestions to Inventors as to Inventions Needed. We invite manufacturers to address us regarding inventions they want.
WORLD PROGRESS PUB. CO., INC.
Room 202 Victor Bldg. Washington, D.C.

How to Build ULTRADYNE
MODEL L-2
32 page illustrated book with detailed instructions on drilling, wiring, assembling and operating Model L-2 Ultradyne Receiver. Latest authentic edition by R. E. Lacault, A.M.I.R.E., inventor of the Ultradyne, the most selective receiver known. Write for descriptive circular.
PHENIX RADIO CORP.
5-7-9 Beekman St., N. Y.

LUDEN'S Menthol COUGH DROPS
Makes Breathing Easier
THE famous LUDEN Menthol Formula gives quick relief to the Trouble Zone—your nose and throat. 5c.

WURLITZER

Couldn't Play a Note—

Now Makes $100.00 a week

"Bill Carola" Landaus Serenaders

Read Bill Carola's story in his own words—

"When I sent for your catalog, I wanted a Tenor Banjo, but I hesitated a long time as I didn't know a note of music. I finally decided to try it a week, as you offered, and at the end of that time I found I could pick a few notes. Then I started the correspondence course you furnished, and in seven months, even before the final payments on the Banjo were due, I had taken my place in a professional orchestra. Now I am making $100 a week, three times what I made as a clerk. Two of my friends made money with their instruments after five months practice, one a drummer and the other a saxophonist, and neither could play a note when he started. I wish everybody knew how easy it is—anyone who can whistle a tune can learn to play a musical instrument."
Bill Carola

New Offer

Learning to Play Made Easy

FREE We now furnish with every instrument a **Free Scholarship Certificate.** This scholarship entitles you to free tuition in one of the foremost correspondence schools of music in the country. Whether you want to learn to play for profit or only for pleasure, this **Free Scholarship** will make it surprisingly easy for you.

Free Trial Easy Payments

You may have any Wurlitzer instrument for a week's free trial in your own home. No obligation to buy. Payments are arranged in small monthly sums, a few cents a day will pay for your instrument. Wurlitzer instruments are the result of 200 year's experience in musical instrument building. Famous for artistic quality, rich tone value and fine workmanship. Used in the finest bands and orchestras throughout the world.

Free Book

Illustrates and describes every known musical instrument—over 3000 articles. Special offers on complete outfits. Special prices direct to you. We also give you our Free Trial, Easy Payment plan and special **Free Scholarship** Offer. No obligation.

Send Coupon Today

The Rudolph Wurlitzer Co., Dept. 1783
117 E. 4th St., Cincinnati — 329 So. Wabash Ave., Chicago
120 W. 42nd St. New York — 250 Stockton St., San Francisco

Send me your Free Book on Musical Instruments. Also your Free Trial, Easy Payment plan and Free Scholarship offer. No obligation.

*Name*_____

*Address*_____

*City*_____ *State*_____

*Instrument*_____

(State instrument in which you are interested)

Better Shop Methods

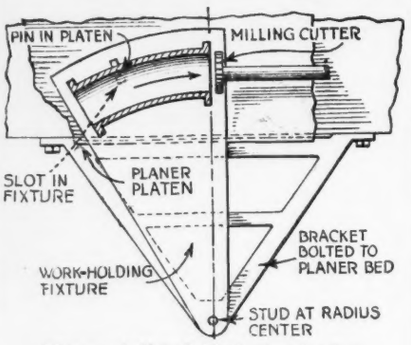
Swinging Fixture Used in Finishing Curved Pipe

By James A. Horton

RECENTLY I saw an interesting method of machining the inside of a curved pipe such as might be used in a cash register system.

The radius of the curve is about 4 ft. A milling attachment is used on the planer in connection with a special attachment for holding the pipe.

A bracket is bolted firmly to the bed of the planer, as shown, and carries a stud that is a distance from the center line of the cutter shaft equal to the radius of the



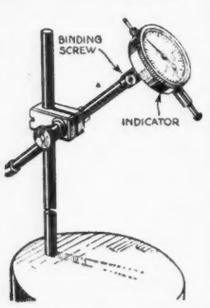
After one-half is finished, the pipe is reversed on the fixture to complete the work

center of the pipe. On this stud is pivoted a fixture for holding the work. It is operated by a T-head pin inserted in the planer bed loosely, but nevertheless a good fit. This moves the fixture when work is being done, but the fixture itself is supported by the planer table.

The fixture is so constructed as to hold the pipe absolutely solid, and is so accurate that the pipe may be reversed, as the milling cutter goes only halfway through at the first operation. To insure the necessary accuracy, the ends of the section and also the periphery of the flanges are finished in advance.

Stand Safeguards Indicator

DIAL indicators have so much hard usage that a substantial stand is one of their most necessary accompaniments. The stand illustrated is firm and rigid and allows the indicator to be set at any angle desired.

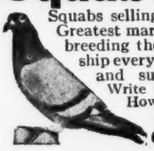


Dial indicator stand

The base is cast iron, tapped to take the ½-in. vertical rod, which is made of cold rolled steel, 14 in. long. The indicator rod is 12 in. long, of ⅜-in. cold-rolled steel. The clamp block is cold-rolled or machinery steel.

One knurled thumb-nut serves to bind both rods. The clamping block can be set up tightly enough to prevent slipping in any direction and still allow a slight movement until the exact setting is made; then it is set firmly.

Squab Book FREE



Squabs selling at highest prices ever known. Greatest market for 20 years. Make money breeding them. Raised in one month. We ship everywhere our famous breeding stock and supplies. Established 24 years. Write now for big illustrated free book, How to Make Money Breeding Squabs.
PLYMOUTH ROCK SQUAB CO.
616 H St., Melrose Highlands, Mass

13 WEEKS FOR 15 CENTS

You've heard your neighbor praise this wonderful weekly magazine that 3 million people read. Unbiased digest of national and world affairs. Chock full of just the kind of reading you want. Science, politics, travel, fun, fashions, question box, books, health—entertainment and instruction for all. Send 15c (coin or stamps) today for this big paper on trial 13 weeks or $1 for 1 year (52 issues).
PATHFINDER, 559 Langdon Sta., Washington, D. C.

CLASS 25¢ PINS

BUY DIRECT FROM THE MAKER
CATALOG FREE

Either pin shown made with any 3 letters and 2 figures. 1 or 2 colors enamel. Silver plate 25¢ ea. $2.50 doz. Sterling silver, 40¢ ea., $4.00 doz.
BASTIAN BROS. CO.
591 Bastian Bldg., Rochester, N. Y.

Motorcycle Bargains

SAVE 25% to 65%

on Slightly Used and Rebuilt Motorcycles, Ace, Indian, Excelsior, Harley-Davidson, Cleveland, Side Cars, Johnson Motor Wheels, Evans Power Cycles, Bicycles. Send for **Free Bargain Bulletin and Money Saving Message,** listing hundreds of bargains in used, rebuilt and new machines, supplies, accessories, etc.
AMERICAN MOTOR CYCLE CO.
Dept. 328 2047 W. Chicago Ave. CHICAGO

AUTOMOBILE MAKES 27 MILES ON AIR

An automobile goes 27 miles on air by using an automatic device which was installed in less than 5 minutes. The automobile was making 30 miles on a gallon of gasoline but after this remarkable invention was installed, it made better than 57. The inventor, Mr. J. A. Stransky, 135 Eleventh Street, Pukwana, South Dakota, wants agents and is willing to send a sample at his own risk. Write him today.—Adv.

PRINT YOUR OWN

Cards, stationery, circulars, labels, book, magazine, paper. **PRESSES, $12 up, Card and Paper Cutters $3 up.** Get more printing at half old cost.

Need MONEY?

Make it printing for others, Big Profits. No experience required; all easy with our printed rules supplied with every press. YOUNG MEN and BOYS here is a chance for you to have a business of your own. Write for catalog presses, cutters, type, cards, paper, ink. **THE PRESS CO., N-33, Meriden, Connecticut**

DEAFNESS IS MISERY

I know because I was Deaf and had Head Noises for over 30 years. My invisible Antiseptic Ear Drums restored my hearing and stopped Head Noises, and will do it for you. They are Tiny Megaphones. Cannot be seen when worn. Effective when Deafness is caused by Catarrh or by Perforated, Partially or Wholly Destroyed Natural Drums. Easy to put in, easy to take out. Are "Unseen Comforts." Inexpensive. Write for Booklet and **my sworn statement** of how I recovered my hearing.
A. O. LEONARD, Suite 301, 70 5th Ave., New York

BURN YOUR NAME ON TOOLS WITH ARKOGRAF

Protect your tools from theft. Write any name, engrave any design on tools and metal with electricity like writing on paper with pen or pencil. Complete outfit $3.50, prepaid anywhere. Interesting descriptive circulars free. Write to-day. Agents wanted.
Arkograf Pen Co., 1171-A East Stark St., Portland, Oregon

MAKE MONEY SELL MADISON SHIRTS

Direct from our factory to wearer.
Easily sold. Over one million satisfied wearers. No capital or experience required. Large steady income. Many earn $100. to $150. weekly. Territory now being allotted. *Write For Free Samples.*
MADISON SHIRT M'F'RS, 505 Broadway, New York

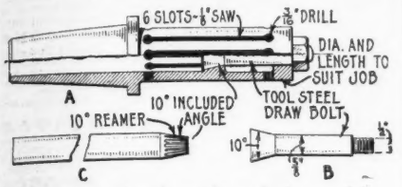
This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Better Shop Methods

Expansive Chucking Arbor for Holding Gear Blanks

THIS arbor is designed for turning and cutting and grinding gear blanks and similar work in the lathe, milling machine, grinder or gear-cutting machine.

It is made of one piece of tool steel, *A*, hardened and ground on the outside to fit the hole in the work, except that .005 in. is allowed for expansion. A draw bolt,



How the arbor is made and the special reamer for finishing the draw-bolt seat

B, bears against a tapered seat and extends through the front end of the arbor.

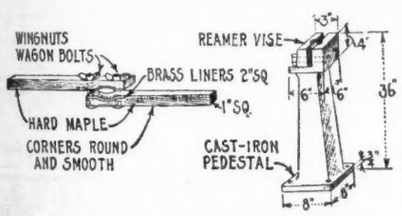
The arbor is drilled clear through and a special reamer, *C*, is made to finish the tapered seat. Six longitudinal slots ⅛ in. wide are cut after the holes shown are drilled.

Floor Stand for Hand Reamer Saves Machinist's Time

REAMED holes in automatic and turret machine work often are sized with a hand reamer to insure accuracy. In most cases this operation can be done by the operator while his machine is running, provided he does not have to leave the machine to use a vise or other tool to hold the work for reaming.

The floor stand shown below, which is a simple casting made in two pieces, is bolted to the floor in the most convenient position for the machine operator.

The hand reamer is held in the V-block, part of which is integral with the main

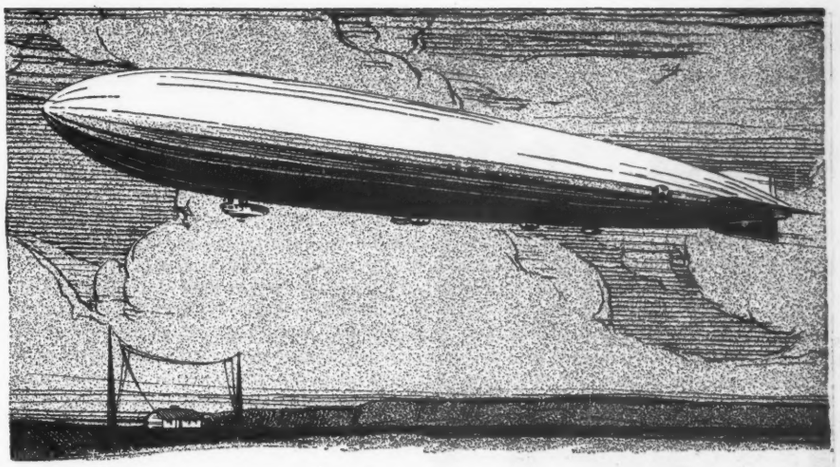


The reamer stand and wooden clamp for holding the work to be reamed

casting, and the other half is movable to take reamers of different sizes. The square shank of the reamer is clamped in a vertical position by tightening two cap screws.

As soon as the operator removes a piece from the machine, he clamps it in wooden clamps, which give a good leverage for turning the piece on the hand reamer.

Straight bushings or small irregular castings may be held conveniently and reamed rapidly with this outfit. If the machine is semi-automatic or hand-operated, the operator starts another piece before reaming the preceding one, so as not to lose any production time.—H. L. W.



DUBILIER CONDENSERS

Important Links between the Shenandoah and Land!

COMMUNICATION with land—under all conditions—at all times—this was the imperative need of the Shenandoah on its experimental flight across the continent. Impressed with this need, army and navy engineers equipped both transmitting and receiving sets with Dubilier mica condensers—not specially designed condensers, but the regular standard product. Only complete confidence in the supreme reliability and efficiency of Dubilier condensers can explain their use in this important and daring adventure.

Ⓢ **Dubilier**

CONDENSER AND RADIO CORPORATION

Lightness combined with *unusual strength*

THIRTY years' experience in canoe building lie back of every Carleton Canoe. Year by year we have improved and perfected them. In the 1925 Carleton Canoe, we believe that we have achieved the ultimate in canoe manufacture.

The Carleton is a light canoe. It is beautifully balanced and handles easily under heavy loads. Carleton Canoes are very low in price too.

Our new illustrated catalog gives prices and complete information. Write today for your free copy. THE CARLETON CANOE CO., 73 First Street, Old Town, Maine, U. S. A.

CARLETON CANOES

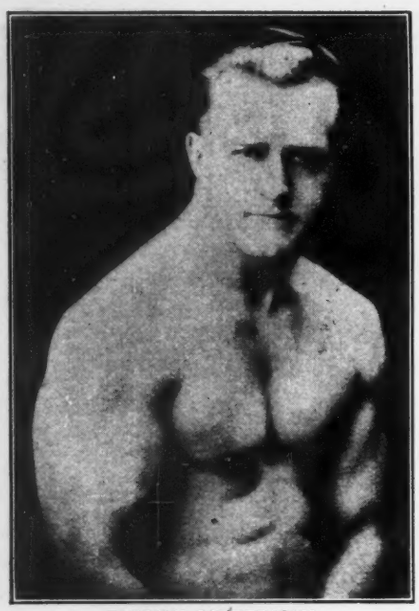
Save $1000 When You Build

LITTLE mistakes often run into a $1,000 or more. Keith's remarkable new book and Keith's Magazine show how to avoid these costly errors—also many short cuts that save money. This amazing book, "Beautiful Homes," contains two hundred actually tested plans. Shows all types of houses,—Stucco, Brick, Tile or Frame. Gives fashionable new ideas on Interior Decoration. With this De Luxe Plan Book you receive a year's subscription to Keith's Magazine, the recognized authority on home building for twenty-five years. Just send your name and address and pay postman only $3 plus a few cents postage upon arrival. Write at once.

KEITH CORPORATION, ARCHITECTS
100 N. 7th St. Minneapolis, Minn.

Keith Corporation, Architects,
100 N. 7th St., Dept. 19-C
Minneapolis, Minn.
Send me "Beautiful Homes" De Luxe Edition and a year's subscription to Keith's Magazine. I will pay the postman only $3 plus a few cents postage.

Name .....
Address .....
City ..... State .....
If you send $3 with order, book will be sent postage prepaid.



EARLE E. LIEDERMAN
The Muscle Builder

How Long Do You Expect to Live?

Make your own answer. It's up to you. I know you might be hit on the head with a brick or be pushed off the end of a dock. But barring accidents, what then? If you take care of an automobile it will last for years—abuse it and you might as well cash it in after the first year. This is just as true of your own body.

IF YOU DO—YOU DIE

Go ahead with your careless living if you want. Eat and drink what you like. Abuse your body—it's yours to do with as you please. You may think you're having a good time. But are you? You get up in the morning feeling half dead. You drag yourself through the day. Don't you know your body is clogging up with poison? Don't you know your lungs are starving for oxygen? Don't you realize your inner cells are breaking down and you are not doing a thing to replenish them? You're dying, man—and you don't know it.

I ADD YEARS TO YOUR LIFE

You need exercise. You must have it. Tie your arm to your side and it will wither away—but use your muscles and you have more muscle to use. Every vital organ is completely surrounded with muscles which make those organs function. Exercise and you strengthen the organ itself. You wear down the dead tissue. The white corpuscles of your blood carry them off and the red corpuscles supply new healthy tissue. You drive death and disease out and bring new life to a worn down and famished body.

YOU NEED A TEACHER

Just any kind of exercise won't do. I have had men come to me who were literally broken down from work in factory or mill. With scientific instruction I brought them back to strength and power.

My system has been tried and proven. It never fails. Some claim, eh? Well, it's true. I don't care what your present condition is. I'll knock those microbes higher than a cocked hat. I'll shoot you full of life and vitality. And muscle? That's my middle name. In three months' I'll build up every muscle in your body. I'll broaden out those shoulders and deepen your chest. Every breath will bring deep loads of oxygen to your lungs, purifying your blood and shooting a thrill throughout your entire system. I'll brighten your eyes and clear your skin. I'll make you so full of pep you will feel like shouting out to the world: "I'm a man and I can prove it."

And remember, fellows, I don't just promise these things—I guarantee them. Do you doubt me? Make me prove it. That's what I like, because I know I can do it. Come on, then. Snap into it. Are you ready? Let's go.

Send for new 64-page book

"MUSCULAR DEVELOPMENT"
It is FREE

It contains forty-five full page photographs of myself and many of my prize winning pupils. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now, and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will literally thrill you. All I ask is 10 cents to cover the cost of wrapping and mailing. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today, right now, before you turn this page.

EARLE E. LIEDERMAN
Dept. 1303, 305 Broadway, New York City

EARLE E. LIEDERMAN
Dept. 1303, 305 Broadway, New York City.

Dear Sir:—I enclose herewith 10 cents, for which you are to send me, without any obligation on my part whatever, a copy of your latest book, "Muscular Development." (Please write or print plainly.)

Name.....

Street.....

City..... State.....

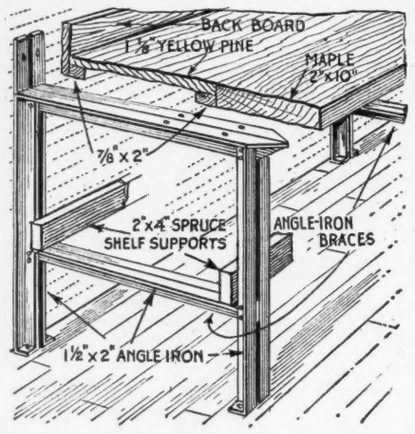
Better Shop Methods

Substantial Bench Made with Legs of Angle Iron

FREQUENTLY the garage owner or small-shop man wishes to make a few good bench legs. For this he can use 1½- or 2-in. angle iron, without any machining except drilling and either sawing or careful cutting with an acetylene torch.

The height and width of the legs depend upon the builder. For a bench 10 ft. long, three legs will be sufficient. The pieces of angle iron are cut out in pairs, as shown, and all joints are fastened with ⅜-in. rivets or welded, the latter being preferable. The upward projection at the rear is for a ⅞-in. back board and should be 6 in. high.

For the top of the bench my preference is for a 2-in. maple plank, planed on both



Stock 1½- or 2-in. angle irons are welded or riveted together to form rigid bench legs

sides and bolted down with 3-in.-long carriage bolts. The holes are plugged tightly with spruce turned to fit. The backboard is put on with ¼-in. carriage bolts and nailed at intervals to the ⅞ by 2 in. piece.

A piece ⅞ by 2 in., and as long as necessary, is placed against the front of the back board and a similar piece is nailed against the back of the maple plank. The space between the back edge of the maple plank and the back board is filled with 1⅛-in. matched pine of the first grade, or the same thickness of the second grade maple flooring, which should be tongued and grooved, laid tight by crossways of the bench, and toe-nailed.

For the bottom shelf, use 2 by 4 in. spruce supports and fill in with ⅞-in. spruce crossways of the bench nailed with eightpenny cement-coated nails. The bench top should be planed and finished with orange shellac.—A. S. JAMIESON.

Lapping a Micrometer Spindle

A MICROMETER spindle, through long continued use, wears on the end so that it is not square with the anvil. To square up the end, make a fiber bushing to fit snugly over the spindle. The hole should be reamed and the bushing faced square. Remove the spindle from the micrometer, place it in the bushing, and lap the end until square, using a cast-iron lap with flour emery and gasoline.

YOU TOO CAN PLAY THE HAWAIIAN GUITAR
JUST AS THE HAWAIIANS DO!
PLAY ALL THE LATEST HITS

ONLY 4 MOTIONS used in playing the fascinating Hawaiian Guitar. Our native Hawaiian instructors teach you to master them quickly. Pictures show how. Everything explained clearly.

PLAY IN HALF HOUR After you get the 4 easy motions, you can play harmonious chords with very little practice. 40,000 students have learned to play in this easy, pleasant way.

EASY LESSONS The 52 printed lessons with a great many pictures make it easy to learn quickly. You don't have to know how to read notes. No previous musical knowledge necessary. You learn to play any kind of music, and pay as you play.

FREE GUITAR As a special offer to new students we give this full size, high grade instrument free of charge. It is sent at once without red tape or delay.

WRITE AT ONCE Send your name at once and let us tell you all about the 52 easy lessons and the free guitar. You have everything to gain. Don't put it off. A post card will do. Ask for new special offer and easy terms.

Special courses on Violin, Tenor-Banjo, Banjo-Ukulele and Ukulele

First Hawaiian Conservatory of Music, Inc.
233 Broadway (Woolworth Bldg.) Dept. 46, New York, N. Y.

Mason, Fenwick & Lawrence
Patent and Trade-Mark Lawyers
Washington, D. C. :: New York :: Chicago

Established over 60 years. Write us.

References: National Confectioners' Association, Chicago; National Canners' Association, Washington, D. C.; Life Savers, Inc., Port Chester, N. Y.; Bon Ami Co. and U. S. Cigar Co., New York City; Hershey Chocolate Co., Hershey, Pa.; Stephen F. Whitman & Son, Philadelphia, Pa., and many others.

Inventions protected. Trade marks registered.

Big Value for 10 Cts.

6 Songs, words and music; 25 Pictures Pretty Girls; 40 Ways to Make Money; 1 Joke Book; 1 Book on Love; 1 Magic Book; 1 Book Letter Writing; 1 Dream Book and Fortune Teller; 1 Cook Book; 1 Base Ball Book, gives rules for games; 1 Toy Maker Book, Language of Flowers; 1 Morse Telegraph Alphabet; 12 Chemical Experiments; Magic Age Table; Great North Pole Game; 100 Conundrums; 3 Puzzles; 12 Games; 30 Verses for Autograph Albums. All the above by mail for 10 cts. and 2 cts. postage.

ROYAL SALES CO., Desk 215, Norwalk, Conn.

ADDING MACHINES
Your choice of Burroughs, Dalton, Wales and all standard makes often at less than one-third regular price! All sizes and styles. Every machine guaranteed A-1 condition. Rebuilt by experts.

1/3 PRICE

SOLD ON INSTALLMENTS
You can buy a regular $300 machine for as low as $5 down. Why pay big prices? Hundreds of well-known firms our customers. Write for FREE list of models and bargain prices that save you money. Do it NOW.

RELIABLE ADDING MACHINE CORP. Dept. 103
168 W. Washington Street CHICAGO, ILL.

THIS ENGINE FREE
For A Whole Month
SEND NO MONEY

Your request to try this OTTAWA Engine is all we ask. Don't send a penny. Try engine 30 days. Then make small monthly payments. Sent direct from factory. Tested 3 times before shipped. Use Kerosene or Gasoline. Sizes 1½, 2¼, 3½, 5, 7 and up to 22 H.P. One year to pay.

FREE BOOK "How to Know Better Engines" tells why thousands use the OTTAWA instead of other engines; why start easier, and economical to run. Send your name on card today.

$4.95 MONTHLY AFTER TRIAL

OTTAWA MFG. CO., Desk 1951 C King Street, Ottawa, Kansas
1951-C Magee Bldg., Pittsburgh, Pa.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

PATENTS
TRADE MARKS-COPYRIGHTS

PROTECT YOUR INVENTION

ANY NEW article, machine, design or improvement thereof, or any combination of parts or improvements in any known article which increases its efficiency or usefulness, **may be patented,** if it involves invention.

If You Have Any New Ideas

which you feel are useful, practical and novel, take prompt action to **protect your rights.** If you have invented any new machine or new combination of parts or improvement, or any new design or process, **SEND DRAWING, MODEL OR DESCRIPTION** of it for information as to procedure to secure protection.

DRAFTING and SPECIFICATION ROOM of CLARENCE A. O'BRIEN, Registered Patent Lawyer, Washington, D. C.

All communications are held in strict confidence. My personal, careful and thorough attention is given to each case. I offer you efficient, reliable and prompt service—based upon practical experience. Highest references.

FREE

These Books Free

NO CHARGE FOR ABOVE INFORMATION

Write today for free books, "How to Obtain a Patent" and **"Invention and Industry"** and blank form **"Record of Invention."**

These books will give you valuable information, and they may save you much time and effort. Send for them **now.** My practice is devoted exclusively to United States and Foreign Patents and Trade Marks. Write me freely, frankly and with full confidence; it is very probable that I can help you.

Use the Coupon attached, and immediately upon its receipt I shall send you the form Record of Invention to be returned to me with drawing, description or model of your idea; promptly upon receiving your idea I shall write you as to procedure and costs.

CLARENCE A. O'BRIEN
REGISTERED PATENT LAWYER

Member of Bar of Court of Appeals, District of Columbia, United States Court of Claims; Supreme Court of United States, Supreme Court District of Columbia.

FREE COUPON

CLARENCE A. O'BRIEN, REGISTERED PATENT LAWYER
889C Security Savings and Commercial Bank Building
Directly across Street from U. S. Patent Office, Washington, D. C.

Please send me your free books, **"How to Obtain a Patent"** and **"Invention and Industry"** and blank form, **"Record of Invention,"** without any obligation on my part.

Name .....

Address .....

IMPORTANT—*WRITE OR PRINT NAME CLEARLY.*

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS

Associated since 1846 with the Scientific American

683 WOOLWORTH BUILDING
New York City

522 SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

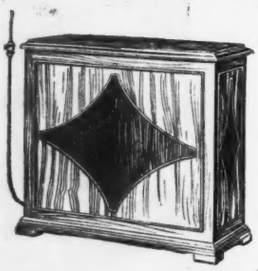
411 TOWER BUILDING
Chicago, Ill.

364 HOBART BUILDING
San Francisco, Cal.

219 VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents
and Trade Marks By Request.
Associates in All Foreign Countries.

The Question of "B" Battery Current Solved with the Kellogg Trans-B-Former



Ⓢ

THE Kellogg Trans-B-Former furnishes the necessary plate voltages for your radio set, from your 110 A C, 60 cycle, electric light socket without any interference.

This unvarying current is furnished at less than one-fifth cent per hour. Throw away your "B" batteries and install a Trans-B-Former and your set will operate at maximum efficiency constantly.

The Kellogg Trans-B-Former will:

Improve reception
Reduce operating cost to a minimum
Add to the appearance of your set

Developed, perfected and guaranteed by the Kellogg Switchboard and Supply Company.
At Your Dealers
Each **$50**

KELLOGG SWITCHBOARD & SUPPLY COMPANY
1066 Adams Street Chicago, Ill.

$25.00 in Prizes

See top of page 8 in front of book for full details

THAT WET BOILER PIT CAN BE MADE DRY!

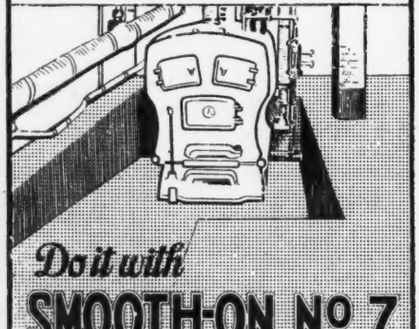
MAKE and keep your cellar walls, floor and boiler and drain pits thoroughly dry by filling the cracks and coating the surface with Smooth-On No. 7, the only practical waterproofing material that can be effectively applied *from inside* and bonds perfectly on *wet or dry* surface. Excellent also for patching concrete floors, waterproofing garage, stable and washroom floors, brick walls, cisterns, septic tanks, water troughs, fountains, fish ponds, swimming pools, manure pits, etc.

Requires about 25 lb. Smooth-On per 100 sq. ft. of surface and you can do the work yourself.

Sold in 5 and 10-lb. cans
25, 50 and 100-lb. kegs

Write for FREE BOOK

SMOOTH-ON MFG. CO.
Dept. 60
574 Communipaw Avenue
JERSEY CITY, N. J.



Do it with
SMOOTH-ON No 7

How Electricity May Solve the Farmer's Problem

(*Continued from page 37*)

According to the Rural Electric Service Committee of the National Electric Light Association, there were, last May, 166,000 farms connected with light- and power-station distribution lines. The most recent estimates of the number of individual power and light sets range from 240,000 to between 300,000 and 400,000. In 1920, according to the census of that year, 452,620 American farms had either gas or electric service. Of these, it is estimated about 348,000 had electric service.

THIS is a rather impressive total when considered by itself. It is not impressive, however, when you consider that the same census showed the aggregate number of farms in the United States to be 6,448,343.

One essential point is being kept in mind by the Minnesota committee which says, in describing the Red Wing experiment:

"The problem of reaching the farmer with electric service is not one of sentiment, and it is not an engineering problem, for if the electrical engineer were given an inexhaustible purse, he could readily extend lines to every farm in America. The problem is really a financial one and the main purpose of this entire project is to determine whether electric service can be extended to the farm on a basis of charges acceptable to both farmer and power company."

It will be noted that stress is laid on the distribution phase of supplying service. This is based on the idea that power is to be furnished from a central light and power station, as it is at Red Wing, rather than by individual light and power sets.

The latter serve a very distinct purpose. They make it possible for the farm situated beyond light- and power-station distribution lines to have the advantages of electricity for lighting, for operating household electrical appliances, for pumping, and some of the lighter kinds of farm work. There are farms so remote from present or prospective light- and power-station lines that it will be years, if ever—barring the finding of new methods of distribution—before light- and power-station service will be available to them. To all such, the individual set is a boon.

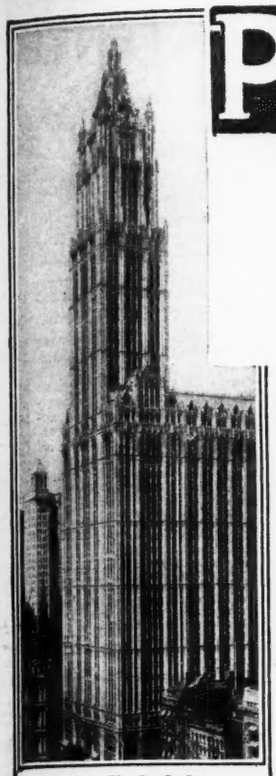
However, light- and power-station service offers a distinct advantage, not only in convenience, but in offering the farmer a practically unlimited supply of power—which the individual set does not. In any broad consideration of the problem, the real electrification of the farms depends on central station service.

THERE are two important factors in the distribution problem that have already been touched upon—the small number of farms to the mile and the small amount of power used by such farms as have been electrified. The farms average, as stated, but few to the mile, whereas in the cities a mile of distribution line serves from 50 to 200

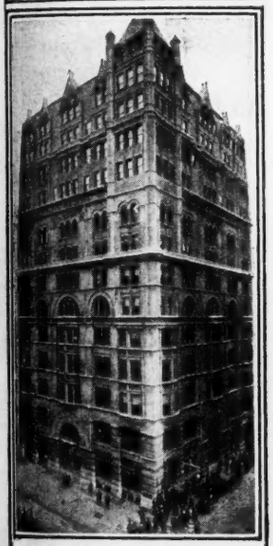
(*Continued on page 162*)

Ⓢ **This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.**

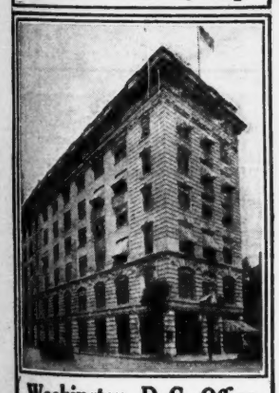
PATENTS TRADE-MARKS AND COPYRIGHTS



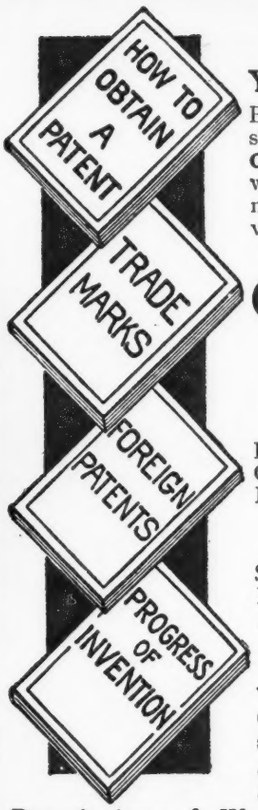
New York Office
Suite 1007 Woolworth Bldg.



Philadelphia, Pa., Office
Suite 714-715 Liberty Bldg.



Washington, D. C., Office
Victor Bldg.



OUR OFFER:

Your first step

Before disclosing an invention the inventor should write for our blank form **"RECORD OF INVENTION."** This should be signed, witnessed and returned to us together with model or sketch and description of the invention for **INSTRUCTIONS.**

NO CHARGE FOR THE ABOVE INFORMATION

Our Four Books Mailed Free to Inventors

Our Illustrated Guide Book

HOW TO OBTAIN A PATENT

Full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described.

OUR TRADE MARK BOOK

Shows value and necessity of Trade Mark Protection. Information regarding *Trade Marks and unfair competition in trade.*

OUR FOREIGN BOOK

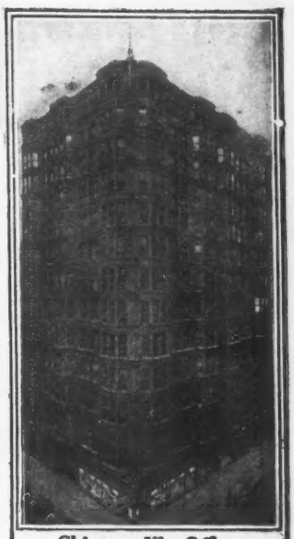
We have Direct Agencies in Foreign Countries, and secure Foreign Patents in shortest time and at lowest cost.

Progress of Invention

Description of World's Most Pressing Problems by Leading Scientists and Inventors

ALL COMMUNICATIONS AND DATA STRICTLY CONFIDENTIAL
INTERFERENCE AND INFRINGEMENT SUITS PROSECUTED

Private Office, Victor J. Evans, with View of Patent Office Through Window



Chicago, Ill., Office
Suite 1114 Tacoma Bldg.

Pittsburgh, Pa., Office
Suite 514, Empire Bldg.

San Francisco, Cal., Office
Suite 1010 Hobart Bldg.

Highest References Prompt Attention Reasonable Terms

VICTOR J. EVANS & CO., Patent Attorneys

Main Offices: 760-9th Street, N. W., Washington, D. C.

FREE COUPON

Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name.....

Address.....

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

$100 for One Good Commercial Drawing

Become An Artist This Easy Way

Thousands who never dreamed they could draw can now easily become artists. **You,** too — without any previous training—and no matter how little apparent talent you have — can now easily learn Illustrating, Designing and Cartooning through this amazingly easy method.

You learn at home, yet your work receives the personal attention and criticism of one of America's most successful artists. Many students actually sell enough work during their training to pay for it many times over.

Big Money in Commercial Art

Millions of dollars are being spent this year on advertising and story illustrations, commercial designs, and cartoons. And even more will be spent next year. Commercial art is a **tremendous** field—and a field where very big money is gladly paid anyone who can produce good art work. Advertisers, magazines, newspapers, printing houses, business concerns all need trained artists. Competent artists easily earn from $50 to far over $300 a week. And now you can easily enter this "world's most fascinating, best paid business."

Mail Coupon for Free Book

A new handsomely illustrated book has just been printed, which gives all the most up-to-date information on the thousands of wonderful opportunities in Commercial Art and shows how this startling new method easily enables you to enter this field. It tells about our students—their success—what they say—actual reproductions of their work—how they made big money while studying. This attractive book will be sent without cost or obligation. Send for it. Mail coupon now.

Washington School of Art

Room 243-C, 1115-15th St., N. W. Washington, D. C.

Washington School of Art
Room 243C, 1115-15th St., N.W., Washington, D. C.
Please send me without cost or obligation your new book on art, "New Easy Way to Become an Artist," and details of your special offer.

Name.....
Please write plainly Mr., Mrs. or Miss

Address.....

City..... State.....

How Electricity May Solve the Farmer's Problem

(*Continued from page 160*)

users. This inevitably makes it more expensive to serve the farms than the towns and cities.

Distribution lines are expensive to construct. Costs vary, of course, and it is impossible to set down a definite figure that will apply to all sections of the country and all conditions. Nor is this the only item that must be considered. The rural line must bear its share of the general overhead. There are losses of energy in distribution. Before a single watt of power has been delivered to the farmer, a considerable expense has been incurred. There are meters to be read—an item proportionately much more expensive in the country than in the city. The line must be kept in repair.

AS STATED, the cost of distribution would be relatively less important if the farmers used a greater amount of current. Therefore, one of the principal objects of the Red Wing experiment and others like it is to find how the farmer can profitably use a larger amount.

The tentative rate set for customers on the Red Wing line was devised to invite a liberal use of power. It is divided into a service charge (which includes interest, depreciation, maintenance, taxes, bookkeeping, meter reading, and core losses) and a charge for the power consumed. The service charge was tentatively set, on the basis of three customers to a mile, at $6.90 a month. The tentative rate for the first 30 kilowatt-hours of power consumed a month is five cents a kilowatt-hour; for all in excess, three cents.

"Applying this rate to actual consumption," says the committee, "it is found that electricity necessarily will have to be counted as a rather expensive luxury by the farmer who cares to use only a little of it. He is very much in the position of a farmer telephoning a store five miles away to send him a cake of yeast. Naturally, the price of the cake of yeast, plus the delivery charges, would make it a costly cake."

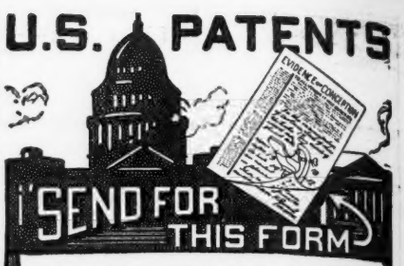
It will be seen that this schedule works out as follows:

The farmer who uses only 20 kilowatt-hours of power a month pays a service charge of $6.90, plus $1 for power, making a total of $7.90, or at the rate of 39.5 cents a kilowatt-hour.

If he uses 100 kilowatt-hours, he will pay the same service charge of $6.90 and $3.60 for power, a total of $10.50, or at the rate of 10.5 cents a kilowatt-hour. The total bill for a farmer using 300 kilowatt-hours would be $16.50, or at the rate of 5.5 cents a kilowatt-hour.

THE suburban territory lying between cities and the surrounding farming districts, and the innumerable villages scattered all over the country, aid to some extent in giving electrical service to the rural sections. In cases where they offer a sufficient load to justify the extension of distribution lines, they bring this service nearer to the farms.

(*Continued on page 163*)



DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form **"EVIDENCE OF CONCEPTION"** to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them,—a post card will do.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE
Registered Patent Attorneys in U. S. and Canada
274 Ouray Bldg.
WASHINGTON, D. C.
Originators of forms "Evidence of Conception."

PATENTS

To the Man With an Idea

I offer a most comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer
6 Owen Building, Washington, D.C.
41-D, Park Row New York City

PATENTS
REGISTERED PATENT ATTORNEY SINCE 1905
CHARLES W. LOVETT SECURITY BLDG LYNN MASS.
SEND FOR FREE BOOKLET

PATENTS
BOOKLET FREE HIGHEST REFERENCES
PROMPTNESS ASSURED BEST RESULTS
Send drawing or model for examination and report as to patentability
WATSON E. COLEMAN, Patent Lawyer
644 G Street N. W., Washington, D. C.

How Electricity May Solve the Farmer's Problem

(*Continued from page 162*)

Present study of farm electrification deals very largely, of course, with immediate possibilities. For example, among the subjects of experiment by the Agriculture Experiment Station of the Alabama Polytechnic Institute are the application of electric drive to grinding feed, sawing wood, pumping water, baling hay, milking, separating cream, churning, corn shelling, feed mixing, clipping machines, grindstones, tool grinders, spray pumps, fertilizer mixers, limestone crushers, seed graders, seed cleaners, peanut pickers, ensilage cutters, incubators, brooders, egg candlers, and other devices, in addition to lighting and the operation of household devices.

COMMUNITY industries that will be studied include creameries, sawmills, grist mills, syrup plants, cotton gins, meat-curing plants, threshers, hatcheries, ice-making plants, canneries, and other undertakings of the kind.

Beyond these is the question of using electricity for plowing, harrowing, sowing, cultivating, and harvesting. It presents difficult problems. But the experience of other countries would seem to prove that they are not insuperable.

The future may show that electricity can be used on a commercial scale to promote plant growth. This offers highly interesting possibilities. Other uses, at present unknown, may be disclosed by research.

If electricity does nothing more than effect a sensible check on the migration to the cities, it will have accomplished a great thing.

Recent Publications

Practical Radio, by James A. Moyer and John F. Wostrel. Up-to-date practical information for the radio enthusiast and experimenter. Illustrated. McGraw-Hill Book Co.

A Hand-Book of Solar Eclipses, by Isabel M. Lewis of the U. S. Naval Observatory. A comprehensive, popular discussion of a most fascinating subject. Illustrated. Duffield & Co.

Hudson Maxim—Reminiscences and Comments, by Clifton Johnson. An entertaining biography of a picturesque leader of the world of invention. Illustrated. Doubleday, Page & Co.

The Boys' Book of the Earth, by Sidney Aylmer Small. Geology made wonderfully interesting for boys or for any one else who enjoys the presentation of scientific fact in lively, non-technical language. Illustrated. E. P. Dutton & Co.

Electrical Amusements and Experiments, by C. R. Gibson, F.R.S.E. Interesting and amusing tricks, illusions, and experiments that can be performed with homemade electrical apparatus. Illustrated. J. B. Lippincott Company.

Fungi and Human Affairs, by W. A. McCubbin. The influence of fungi and bacteria on man's activities, with special reference to plant diseases. Illustrated. World Book Company.

New Model Tungar charges all batteries

On the back of the Tungar, there are three terminals. Slip the wire into one and charge your radio "A" battery, 2 or 4 volt size. Use the second to charge your radio "B" battery, 24 to 96 volt size. Or the third will charge a 6 volt "A" battery or 6 to 12 volt auto battery.

Just clip on the Tungar, and plug it into any electric outlet in the house or garage. Then leave it overnight to charge while you sleep. Very simple.

The Tungar is a G-E product, developed in the great Research Laboratories of General Electric.

The New Model Tungar charges radio A and B batteries, and auto batteries. Two ampere size (East of the Rockies) $18.00

The Tungar is also available in five ampere size (East of the Rockies) . . $28.00

60 cycles—110 volts

Tungar
REG. U. S. PAT. OFF.
BATTERY CHARGER

Tungar—a registered trademark—is found only on the genuine. Look for it on the name plate.

Merchandise Department
General Electric Company
Bridgeport, Conn.

GENERAL ELECTRIC

INVENTORS PROTECT YOUR IDEAS

Send for our Guide Book, **HOW TO GET A PATENT,** and Evidence of Invention Blank, sent Free on request. Tells our terms, methods, etc. Send model or sketch and description of your invention for our **Instructions. No Charge for the Above Information.**

RANDOLPH & CO.
Dept. 130, Washington, D. C.

NAME.....
STREET.....
CITY.....STATE.....

I PAY MEN $100 a week

I pay men $100.00 a week and up by my plan which I want to send you at once. Be your own boss, work where and when you like. You can do fine even without previous experience. Biggest values—positively sell on sight.

Profits in Advance

My plan pays biggest profits and commissions in this line, all paid in advance, we attend to delivering orders and collections.

Sell fine Tailoring

Astonishing values get orders easy when you show samples of our tailored to order, all wool, suits and o'coats—one price $31.50. Our advertising helps you take orders quick.

FREE

This big, fine sample outfit furnished free, contains 100 all wool big samples, all one price $31.50, fine colored fashions, stationery, supplies, tape, etc. All in classy, fine carrying case. Also complete sales manual, we place you in Big Money Class.

$31.50 ONE PRICE W.Z. Gibson

W. Z. GIBSON, Inc., Chicago Ill.
161 West Harrison St., Dept. C-521

Please send me your plan for $100 a week and up, also FREE outfit and sales manual.

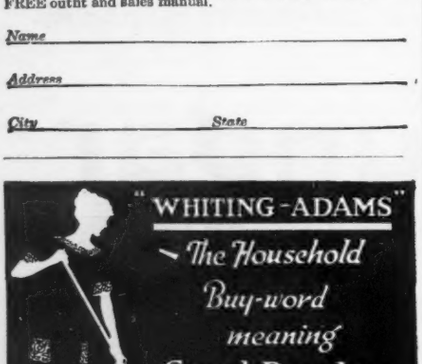
Name _____

Address _____

City _____ State _____

"WHITING-ADAMS"

The Household Buy-word meaning Good Brushes



Look for the name WHITING-ADAMS on every brush you buy. *Whiting* and *Adams* have been household buy-words for brushes for over 116 years — always standing for service and satisfaction.

WHITING-ADAMS BRUSHES

JOHN L. WHITING-J. I. ADAMS CO., Boston, U. S. A.
Brush Manufacturers for Over 116 Years and the Largest in the World

Arithmetic of Electricity

A practical treatise on electrical calculations of all kinds reduced to a series of rules. *$1.50 Postpaid.*

POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York

Why Everybody Is Solving Cross-Word Puzzles

(Continued from page 38)

of cross words traveled. Not to know of them, not to have worked them, soon stamped one as being behind the times.

That, briefly, is the story of the growth of the fad.

However, to know why the cross-word puzzle has come does not explain the extraordinarily violent, even unprecedented hold it has taken on the popular fancy. Why have the people who escaped Chinese games, radio, bridge, golf, and even the movies, succumbed at last to a popular fad? Why is it that the solving of puzzles, which has been practiced to a greater or less extent since the dawn of history, should have waited until the years 1924-25 before becoming a universal pastime?

THE second question possibly is the more easily answered. Cross-word puzzles never could have flourished in the past, for the reason that the level of general education, even a score of years ago, was much lower than at present.

Another reason for their success is that cross-word puzzles are almost the first fad of history the practice of which costs virtually nothing and requires the development of no special physical dexterity, the acquisition of no unusual equipment, the learning of no rules. With a lead pencil, and possibly a pocket dictionary to aid in getting over the hard spots, any one who can write and who possesses the working vocabulary of the average newspaper reader is fully equipped to tackle any but the most difficult cross-word puzzles—and to solve them.

To the psychologist, however, readily occurs an even more potent reason for the amazing popularity of this newest fad. Successfully working out cross-word puzzles, more than any similar amusement that the writers can recall, satisfies a long list of the fundamental desires of human kind. Social distinction, sex, imitation, group loyalty, cooperation, competition, pleasure, play, amusement, humor, curiosity, activity, and constructiveness—all of these ingrained, instinctive wants of man are satisfied merely by printing letters in the proper squares.

SOCIAL distinction certainly is the reward of one who most skilfully and most quickly solves a difficult puzzle on which other puzzle addicts are working. The puzzles appeal to the sex instinct in that they supply a new reason for social gatherings, of young people particularly. The puzzles never would have attained their present popularity were it not for the imitative appeal that caused one person to start doing puzzles because his neighbor was doing them. Group loyalty and cooperation are manifested strikingly in the bonds that join puzzle fans, no matter how widely their other interests may differ.

Any one who has ever worked a puzzle will admit that it satisfies the desire for competition, play, pleasure, and amusement. Humor finds its way into the game in many ways—sometimes in the far-fetched definitions that are given for the

(Continued on page 165)

FREE

To Each Purchaser of a World Battery

A 24-Volt "B" Storage Battery positively given FREE with each purchase of a WORLD "A" Storage Battery. The WORLD Battery is famous for its guaranteed quality and service. Backed by years of Successful Manufacture and Thousands of Satisfied Users. You save 50%.

Prices That Save and Satisfy

Auto Batteries		Radio Batteries	
6-Volt, 11 Plate	$12.25	6-Volt, 100 Amps.	12.50
6-Volt, 13 Plate	14.25	6-Volt, 120 Amps.	14.50
12-Volt, 7 Plate	17.00	6-Volt, 140 Amps.	16.00

Shipment Express C. O. D. subject to examination. 5 per cent discount for cash in full with order.

2-Yr. Guarantee Bond in Writing With Each World Storage Battery

proves satisfactory World performance. Mail this ad with your name and address—we will ship battery day order is received; and give you your choice of "B" Storage Battery or a handsome nickle finish Auto Spotlite, FREE. Write TODAY.

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 7 CHICAGO, ILL.

This FREE "B" Storage Battery takes the place of dry cell "B" batteries. Can be recharged and will last indefinitely. To be sold retail for $6.00. It is the only battery of its kind equipped with solid rubber case—and insurance against acid and leakage. Take advantage of this remarkable introductory offer NOW. (To those who prefer it, we will send FREE a handsome nickel finish Auto Spotlite, instead of the "B" Battery. Be sure to specify which is wanted.)

GIVEN FREE

To introduce this new and superior World "B" Storage Battery to the Public

POLY PLUG

75¢

POSITIVE POLE PLAINLY MARKED

With Polyplug you get maximum clearness from your set, because you can't mistake the positive pole. *The positive pole is plainly marked on the sleeve contact.*

Polyplug has no screws to tighten—no need to take plug apart. Wires are crossed under the tension slot—exclusive Polyplug feature—and plugged in. Pulling and jars do not disturb contact.

Permanent Positive Contact
Made of Genuine Bakelite

Send for Circular H
POLYMET Mfg. Corp.
70-74 Lafayette Street
New York City

I'll Pay You $150 A Week

Introducing my amazing new Super-Automatic Washer. Fits in any wash boiler—washes large family washing in 30 minutes; creates its own power—shooting 64 jets of hot, soapy, sudsy water constantly through the clothes. No work or rubbing. No electricity, gas engine or hand power. Greatest invention of age. Costs only a few dollars complete. Fully guaranteed. Sells like wildfire.

FREE OUTFIT to workers—No capital or experience necessary. Full or spare time. Cash profits daily. Schaar made $34.50 first two days—Bryce made $645 in one month. You can do the same. No charge for exclusive territory. Write for Free Outfit Offer today. MERLE MFG. CO., Dept. 3-V Aurora, Illinois.

Why Everybody Is Solving Cross-Word Puzzles

(Continued from page 164)

missing words. Curiosity, activity, and constructiveness unquestionably are displayed by every one who tries a puzzle.

But does performance of the puzzles, as we hear it frequently maintained, actually "improve the mind"? Cross-word puzzles are confidently supposed to increase our power of concentration, to help our memory and our reasoning ability, and, by demanding decisive judgments, are even regarded as an aid to the will!

It would require a whole course in psychology to present an adequate criticism of these views. Suffice it to say that we no longer believe in vague, general "faculties of the mind." A person may strengthen the biceps in his arm by pulling chest weights and find this increased strength useful in playing baseball or hoeing potatoes; but it does not by any means follow that the brain behaves in the same way.

AS A matter of fact, it does not. Muscles are organs of contraction, whereas nerves are conducting organs. Like a telephone system, they convey messages. The effect of exercise, of education, is to plug in certain connections more firmly so that they become relatively permanent. Then it becomes easier and easier to send a new message if we use the old connections. But it also becomes harder to send a message that requires that the old connections be broken up and new ones formed.

Thus exercise, which increases the efficiency of the muscles, actually may impair our ability to perform certain mental operations. This phenomenon is known as interference.

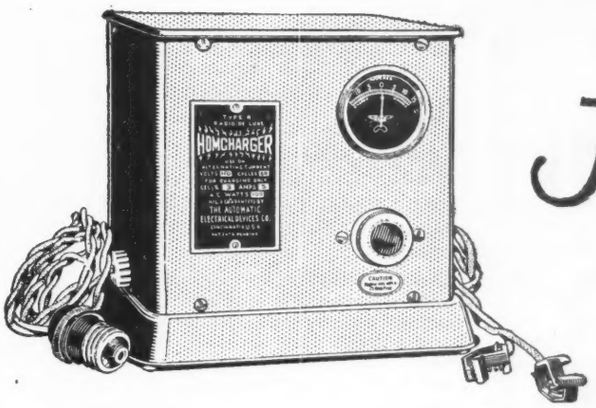
Fortunately there is no interference effect, so far as is known, in connection with cross-word puzzles. Language practice is generally valuable because we use language a great deal. But neither is there any marked degree of "carry-over" into other activities. Doing cross-word puzzles may improve your mental habits somewhat in that it causes you to concentrate more narrowly than may be your wont, but it is altogether unlikely that it will improve your thinking in other fields.

IF YOU wish to increase your efficiency in studying French, or in tinkering with radio outfits, or in playing bridge, or in selling life insurance, the best thing to do is to practise thoughtfully and intensively in the field you wish to improve. Cross-word puzzles will increase your vocabulary, yes. Perhaps they will play a useful rôle in keeping you out of mischief. But as for promoting any general improvement of the mind, neither cross-word puzzles nor any other single discipline can be expected to have much effect.

So do cross-word puzzles if you will, but be honest with yourself and admit that you do them for the same reason that you go to the theater or read novels—for the fun of it. Innocent amusement is sufficient excuse in itself, and cross-word puzzles are innocent amusement—nothing more nor less!

Handsome - Safe - Fast

GOLD SEAL HOMCHARGER



fast!

—charges in one-third the time required by 2 or 3 ampere chargers.

Radio's Most Popular Battery Charger

OVER 250,000 Radio fans have found the big capacity 5 ampere GOLD SEAL HOMCHARGER ideal for keeping their Radio batteries fully charged and operating at top efficiency. Connects to any lamp socket and charges all Radio "A" and "B" and Auto Storage Batteries overnight for a nickel.

Simple, reliable, fool-proof. Can be operated by any one. Contains no bulbs, acids or fast wearing carbon contacts. Only one moving part, replaceable for $1.00 after thousands of hours' use.

Absolutely safe—no danger of shock or fire. Approved by Insurance Underwriters everywhere. Beautifully finished in mahogany and gold. May be used right in the finest living room. Price, $18.50 complete for all currents.

Sold by all good Radio dealers, or shipped charges prepaid upon receipt of purchase price.

THE AUTOMATIC ELECTRICAL DEVICES CO.
131 W. Third St., Cincinnati, Ohio

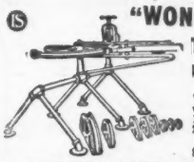
Free *Largest Manufacturers' vibrating rectifiers in the world.* Write for booklet, "The Secret of Distance and Volume in Radio," containing information on this subject and fully describing the GOLD SEAL HOMCHARGER. *Free*

PLANS for HOMES

"The New Colonials" 50 Houses—6 to 10 Rooms—$1
"All American Homes" 50 Houses—7 to 10 rooms—$1
"South-West Stucco Homes" 75 Duplexes & Bungalows—$1
"West Coast Bungalow Books" 5 to 7 Rms. $1; 3 to 5 Rms. $1

E. W. STILLWELL & CO., Architects, 289 Calif. Bldg., Los Angeles

"WONDER" COLD PIPE, TUBING & BAR BENDERS
HAND and MOTOR OPERATED



14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
8" pipe $1.00
Send for Catalogue.

AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. Boston, Mass.

I Offer You $100 a Week

Without experience, training or capital you can establish a big business for yourself. Be your own boss, work when you please, spare time or full time, and make from $25 to $100 a week.

Ford Auto Given Free

We want men and women to represent us. Wonderful plan. 350 Household Necessities direct from factory to home. We provide all instructions and equipment including automobile. Write quick for offer.
AMERICAN PRODUCTS CO., Dept. 1176 Cincinnati, Ohio.

Approved!

MAGNATRONS have received the unqualified approval of radio engineers and radio fans alike. All who have ever used these vacuum tubes have become convinced that they have no superiors.

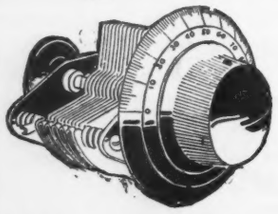
MAGNATRONS have been approved by the Popular Science Institute. After thorough tests by engineers of recognized standing, this institute has given its endorsement.

MAGNATRONS will give better results in *your* set. The improvement in tone and volume and distance will surprise you. Ask your dealer *today!*

CONNEWEY ELECTRIC LABORATORIES
309 Fifth Avenue New York City

MAGNATRONS

Q-U-A-L-I-T-Y



Based on Perfection of Parts—in

U. S. Tool Condensers

A CONDENSER is no more efficient than its weakest feature—a thought borne constantly in mind in designing and making U. S. Tool Condensers. As a result, the gradual perfecting of each part has led to the nearest point approaching condenser perfection. Ask your dealer to show you Type 6, with the micrometer dial.

FACTORY GUARANTEE

Write for Literature

U. S. TOOL COMPANY, INC.
127 Mechanic St. Newark, N. J.
Mfrs. of Special Tools, Dies, Jigs, Automatic Machinery and Sub Presses

Now Comes the Air Taxi

(*Continued from page 47*)

Another safety device is the adjustable wing. The larger the lifting surface the less the speed may be. A racing machine must dash along at a terrific rate to get off the ground. The same plane with double-length wings can take off at about 25 or 30 miles an hour. This fact has led to building wings that can be contracted after the plane gets well clear of buildings and other traffic. By this means accidents should be reduced greatly.

MULTIPLICATION of motors is another barrier between the passenger and harm. Four motors mean that the chance of breakdown is four times less than with one motor. Special landing gear to break the force of an emergency drop in rough ground has been designed. A new-type compass that prevents the pilot from getting off his course has been invented. Self-stabilizers make it nearly impossible for a machine to be upset by a sudden gust of wind. Constant radio communication and guidance add a sustaining tone of reassurance to the passenger cabin. Speaking broadly, air transportation is just like the subway, the auto, the steam railway, and all the other mechanical vehicles of the age — early stages of development were stained with tragedy, and only after many safety devices were perfected was public confidence won.

The type of air taxi we may expect will be somewhat different from that in use today. Between our Eastern coast cities fast planes are in service carrying but a few passengers, two or three as a rule. Between Paris and London flies a type that is comparable only to a private yacht. The latest plane carries 19 passengers and baggage. It covers the 245 miles between the French and British capitals in about 1½ hours, or at an average speed of nearly 140 miles an hour. This machine is equipped with four engines and carries a useful load of 1½ tons.

A similar "sky bus" is being manufactured in the United States by what is characterized as the "first air Pullman company in America." Thirty of the buses are in process of construction and will be in operation soon. Seven passengers and more than a ton of baggage will be carried. The passenger cabin hangs below the wings, permitting a view in every direction. The cabin contains six long, deep upholstered seats with plenty of leg room, facing each other in pairs, and with card- or dining-tables between. Radio, dining, sleeping, and first-aid equipment will be of the finest.

BUT by far the most fascinating prospect lies in the direction of the "flivver taxi." It has been said on good authority that Henry Ford contemplates the possibility of turning them out in vast numbers in his plant at Dearborn. He is quoted as saying: "As soon as we know as much about them as we do about automobiles, and that will not be long, then they can be manufactured by the thousand or by the million."

(*Continued on page 167*)

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Now Comes the Air Taxi

(*Continued from page 166*)

An advanced edition of the flivver taxi came not long ago in the shape of the little speeder brought to this country by the Frenchman, Georges Barbot. The total weight of his plane was only 400 pounds, engine and all. In quantity, it could be manufactured for less than $500, which puts it in a class with our cheapest automobiles. It was able to make 60 miles on a gallon of gasoline. M. Barbot declares that eventually he will make 125 miles on the same amount.

The British "Wren" is another flivver-type plane. It weighs only 335 pounds, carries a two-cylinder engine, and is said to get 100 miles on a gallon of gas. The weight given includes pilot and fuel. Empty, the little craft tips the scales at just over 200 pounds.

The significance of planes of this type lies chiefly in economical operation. Rail travel at three cents a mile seems pretty cheap on first sight when compared with the present air-taxi service of about 35 cents a mile. But other factors must be taken into account. A taxi-plane travels from three to four times as fast as a train and covers (because of its crow flight) only about 70 per cent of the distance. What this means may be gathered from a statement by a banker to the writer. He said: "I estimate that $1,000,000 is saved every three days to the banking interests of this country by the air mail. The reason is that the interest charges on securities is less than half during transportation by air than it usually is by rail."

IN THIS connection it has been brought out that Europe is a better country for air-taxi service on account of the small distances involved. Yet the very fact that our distances are so great is what will assure the success of such service in America. With the pressure of business requirements, we shall have to turn to air travel for relief. Thus the air mail, which operated last year at a profit of something close to $100,000, cuts from 86 to 90 hours from the rail time necessary for a transcontinental trip.

Few people realize that the Government has gone unostentatiously forward in the development work necessary to the success of commercial flying. The Army and the Navy and the Postal Service have given much study to meteorological conditions over our country. A "model airway" has been developed by army fliers connecting the various army aviation centers from coast to coast. Planes travel over this route exactly as trains traverse the lines of a big railway. All planes move on schedule and receive radio instructions from headquarters.

The whole country already has been mapped from the air, showing the best air routes between any two points. An aviator who never has flown in the United States can get into a plane at any army base and find his way to the smallest village in the country by this means. He is supplied with index cards showing routes, directions, and mileage for the entire area. In fact, the present-day air guide-book is very little different from our auto Blue Book.

Balkite Battery Charger. Charges 6 volt "A" storage batteries.
Price $19.50
West of Rockies $20
In Canada $27.50

Balkite "B"—replaces "B" batteries and dry cells. Operates from light socket.
Price $55
In Canada $75

An unfailing power supply for both circuits

Here at last is an unfailing power supply for your radio set. Balkite Radio Power Units furnish constant uniform voltage to both "A" and "B" circuits and give your set greater clarity, power and distance. The Balkite Battery Charger keeps your "A" storage battery charged. Balkite "B" replaces "B" batteries entirely and furnishes plate current from the light socket. Both are based on the same principle, are entirely noiseless, and are guaranteed to give satisfaction. *Sold by leading radio dealers everywhere.*

FANSTEEL
Balkite *Radio Power Units*

BALKITE BATTERY CHARGER — BALKITE "B" PLATE CURRENT SUPPLY

Manufactured by FANSTEEL PRODUCTS CO., *Inc., North Chicago, Illinois*

$542.00 Earned IN ONE MONTH

A New Business—Big Business

A Business to Enthuse Over — The "Ideal" Lawn Mower Sharpener

A wonderful invention that sharpens lawn mowers scientifically—quickly—perfectly; does the work as nothing else can.

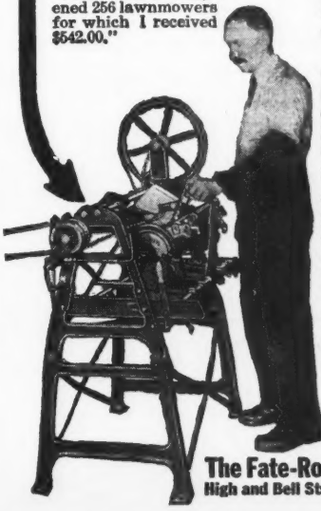
FRED C. MILKERT OF ROSELLE, ILL., WRITES: "The Ideal Lawn Mower Sharpener put me in business, starting in the basement of my home and forcing me now for the third time to move into bigger quarters. Today the dream of my life — a shop of my own — is realized. With a machine like yours and a little hustle any man can have a business of his own and be independent."

D. H. NOAKES, MILFORD, OHIO, WRITES: "Several years ago I started sharpening mowers in a 10 x 10 shed. Today I own a store of my own on Main Ave., No. 212, valued at $8,000.00. The 'Ideal' Grinder did it all."

FRED MILKERT, Roselle, Ill. writes: "Last June I sharpened 256 lawnmowers for which I received $542.00."

W. F. KENDT, BUFFALO, writes: I sharpened 994 lawnmowers last season, and the receipts were nearly $2100.00 which is not bad for a side line."

ZENO BRANDON, MIDDLETOWN, OHIO, writes: "I made $820.70 in 55 days with my 'Ideal.' Have made as high as $38.70 in one day."



You Start Now No town too small. Lawn mowers are dull—owners don't know where to get them sharpened. Mowing the lawn dreaded because of dull or improperly sharpened mower. Lawn mowing healthful, invigorating and pleasant when Mower is "Ideally" sharpened. You do the work scientifically—you are in big demand.

Lawn Mowers Sharpened to Razor Edge— People glad—owners delight in mowing lawn with mower sharpened on an "Ideal." Mower runs light—click-click-click and the grass is cut. Build permanent business for yourself. Start now!

WRITE TODAY

Free —Detailed illustrated catalog and booklet "Let George Say It." Write today.

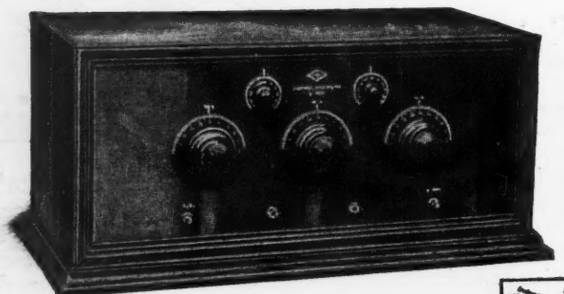
The Fate-Root-Heath Co.
High and Bell Sts., Plymouth, O.

USE THIS—MAIL IT TODAY
The Fate-Root-Heath Company
High and Bell Sts., Plymouth, O.
Please mail at once free Illustrated Catalog and booklet "LetGeorgeSayIt."

Name.....
Address.....
.....

MURDOCK NEUTRODYNE

Now $92.50



Announcing

NOTICE

If your dealer doesn't sell Murdock Products write for beautifully illustrated booklets giving complete description of all Murdock Products.

The *new* Murdock 5-tube Neutrodyne with "B" battery compartment—backed by 20 years experience in making fine Radio Products.

WM. J. MURDOCK COMPANY, 430 Washington Ave., Chelsea, Mass.

Sales Offices: New York, Chicago, San Francisco, Washington, D. C.

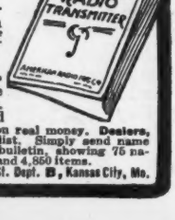
Ⓢ MURDOCK RADIO PRODUCTS

Standard since 1904

$25.00 in PRIZES See top page 8 in front of book for details

FREE RADIO CATALOG Sent You Every Month

ALL the latest improved apparatus is listed in our monthly bulletin: "The American Radio Transmitter." If it's new we have it.



Lowest Prices in U. S.

Our prices to dealers are the lowest in the United States. All nationally advertised goods at discounts that make you real money. Dealers, get your name on our mailing list. Simply send name today for latest, big monthly bulletin, showing 75 nationally advertised factory lines and 4,850 items.

AMERICAN RADIO MFG. CO. 6 W. 14th St. Dept. B, Kansas City, Mo.

PATENTS As one of the oldest patent firms in America we give inventors at lowest consistent charge, a service noted for *results*, evidenced by many well known Patents of extraordinary value. *Book, Patent-Sense, free.* Lacey & Lacey, 648 F St., Wash., D.C. Estab. 1869.

PATENTS

TRADE-MARKS, COPYRIGHTS AND PATENT LITIGATION

Write for advice and instructions how to proceed, costs, etc.

Hand Book with illustrations of 100 Mechanical Movements sent free on request.

ALBERT E. DIETERICH

Patent Lawyer and Solicitor

Successor to Fred G. Dieterich & Co.

681A Ouray Bldg. WASHINGTON, D. C.

A New Way to Fame

(*Continued from page 54*)

frightful catastrophes in the history of the world, was forecast by a rain of ash that fell over the surrounding country for a couple of weeks before the eruption. The inhabitants of the city of St. Pierre did not heed the warning, though, and were destroyed.

To people who live in lands where volcanic eruptions are unknown the reason for such a science as volcanology probably is not apparent, and yet the study of volcanoes bears an intimate relation to them, no matter where they live. Mount Rainier in Washington, Mount Shasta in California, and other great mountains of the United States are potentially active volcanoes. A few miles below the streets of cities like New York and Chicago there is lava, for the whole surface of our earth rests on lava. What we are doing is studying the characteristics of this lava at the active volcanoes where its action is to be seen, and we hope to work from them to the volcanoes the activity of which is buried far underground.

THERE are about 425 active volcanoes on earth, but only three or four of them are being studied. On Vesuvius is an observation station, formerly a weather bureau, that was established more than 50 years ago. There are two stations at Asuma in Japan, established by the late Professor Omary, the famous seismologist. There has been a station at Taal in the Philippines since 1911. These and our station at Hawaii are the only ones.

There should be at least 200 stations if the mysteries of volcanoes are to be investigated fully. Forty years ago when there were but a few weather bureau stations, weather forecasters could only generalize. Now, though, with the country studded with stations, telegraphed reports from one to the other permit meteorologists to predict with remarkable accuracy a change in temperature, a storm or some other variation in the weather.

In the same way the crust of the earth could be studied, and its movements followed. Present-day knowledge in meteorology and astronomy — in all sciences in fact—rests on the facts and figures that have been piling up through the years.

FOR young men who are in search of a career I have a suggestion: Become a volcanologist.

It is a calling that offers thrill, adventure, interest, excitement, and the opportunity to perform scientific work of extraordinary usefulness. It is a new profession that is anything but overcrowded, and hence provides for pioneers unusual chances to achieve fame by making new discoveries. These are its advantages. To my mind it has no disadvantages, although others may not agree with me when I tell them that it must be followed for the most part in remote, out-of-the-way places, and that it entails a great deal of patient, hard work without offering a single chance of achieving wealth.

Ⓢ This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Here Are Correct Answers to Questions on Page 79

1. The lowest temperature ever obtained is that of frozen helium gas. This is about 272° below zero C. (458° below zero F.). This is within one degree of what is called the absolute zero, which is a theoretical temperature at which the atomic vibration is supposed to cease altogether.

2. About 310,000,000 cubic miles of water.

3. We are not sure. We know that there is some medium by which radio waves, light waves, and heat waves pass through space.

4. The white corpuscles, called leucocytes, tiny granules of whitish jelly floating in the blood. If a germ gets into the blood, a white corpuscle soon finds it and engulfs the germ inside its own body, where it is killed and apparently digested.

5. There is no exact limit. It depends on the way the current passes through the body, on how long it lasts, on the general health, and so on. Ordinarily there is no danger from the usual house-lighting circuits of 100 to 120 volts, but people have been killed even by these circuits under unusual conditions. On the other hand, persons have survived even several thousand volts when the shock was only momentary.

6. Soap contains a material that has the ability to stick very tight to things. It creeps over their surfaces as a film of oil will creep over the surface of water. When you wash your hands a very thin film of this material creeps underneath particles of dirt sticking to your skin and pushes these loose so that the water can wash them away.

7. Because they slowly use up oxygen and give off carbon dioxide. That is, they breathe just as all other living creatures do, though much more slowly than growing plants or animals.

8. No. Some of them must be liquid. They are too light, in comparison with their size, to be solid. Jupiter, Neptune and Uranus are only about one and a third times as heavy as water, much lighter than any known rock. Saturn is lighter than water.

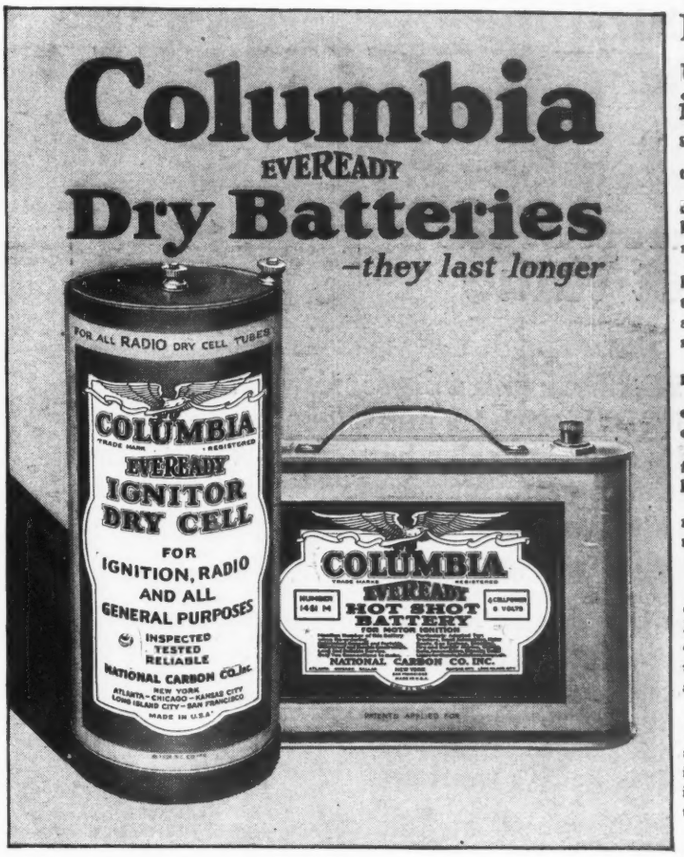
9. The arteries carry the fresh blood outward from the heart to the muscles and other parts of the body. Veins carry the exhausted blood back to the heart and lungs.

10. Scientifically, they are more like the yellow race. It is probable that the negro race split off from the primitive stock of mankind many thousands of years before the whites and the yellows separated into two races.

11. Iridium, a metal that is somewhat like platinum but much harder. This is why it is used for pen tips. It wears away much less rapidly than gold and it is equally resistant to corrosion by the ink. Look at the under side of your pen point and you will see a little whitish speck. That is the iridium.

12. Very little. Since the wave goes out in all directions from the station, the power in it becomes rapidly weaker. Dr. Willis Whitney has calculated that the power exerted by a fly climbing one inch up the wall is equal to the power that would be picked up by a one-foot loop antenna in Schenectady, N. Y., from the Oakland, Calif., broadcasting station during a continuous time of 35 years.

Leaders for a Generation



Popular uses include—

gas engine ignition
telephone and telegraph
doorbells
buzzers
motor boat ignition
heat regulators
tractor ignition
starting Fords
ringing burglar alarms
protecting bank vaults
electric clocks
calling Pullman porters
firing blasts
lighting tents and outbuildings
running toys
radio "A"

Columbia Eveready Hot Shot Batteries contain 4, 5 or 6 cells in a neat, water-proof steel case.

Fahnestock spring clip binding posts on the ignitor at no extra cost to you.

Ask for them by *name* at

electrical
hardware
radio
automobile
marine supply
implement and general stores

FOR years the Columbia Eveready has been the outstanding dry battery. A familiar favorite for a thousand and one every-day electrical jobs. If you discover in this publication or elsewhere something new to try your skill, use Columbia Evereadys for power. They are strong from start to finish. Remarkable for their ability to revive their punch between jobs and to retain their pep and power. For all dry battery uses—Columbia Evereadys. They last longer.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

AGENTS NEW SPARK PLUG
Visible Flash

Just Out—Amazing Invention—**Beacon Lite** Spark Plugs. You see the flash of each explosion in the cylinders. Tells which are firing right. Greatest improvement in spark plugs since gas engines were invented. Wonderful gas savers. Agents coining money.

$90 A WEEK

Easy to make with new sure-fire plans. Sells on sight to every auto owner. Phillips, Ont., writes "Sold 2 dozen today, 3 dozen yesterday. Rush 10 dozen." Write for special **Free** Demonstrator Offer and FREE deal to introduce these wonder spark plugs in your territory. Write quick—**today.**

CENTRAL PETROLEUM COMPANY
526 Century Building Cleveland, Ohio

play a Conn SAXOPHONE

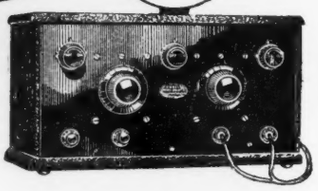
This Free Book tells about exclusive features which make the Conn easiest of all wind instruments to play. Send now for your copy and details of **Free Trial; Easy Payments** on any Conn instrument for band or orchestra.

C. G. CONN, Ltd.
332 Conn Bldg., Elkhart, Ind.

CONN BAND INSTRUMENTS
WORLD'S LARGEST MANUFACTURERS

Creighton Hale, famous movie star and accomplished saxophonist uses a Conn, as do most prominent stars

The Four-Tube $32.50 KODEL Radio's Great Set Value



ANYONE can own a big set now. The four-tube KODEL with its marvelous range and volume, its amazing selectivity, its clear full tone, matches the performance of most expensive five-tube sets, and costs less than half as much.

KODEL is a quality receiver. Sockets and dials are of genuine Bakelite; panel of highly polished Formica; cabinet of handsome black pebbled leatherette —KODEL is Radio's Great Set Value.

Before you buy any set see the complete KODEL line at your radio dealers—"compare the quality."

Here Are All the KODEL Models

S-1 Crystal Set.....$ 5.00
C-11 One Tube Set.....10.00
C-12 Two Tube Set.....18.00
C-13 Three Tube Set.....28.00
C-14 Four Tube Set.....32.50
P-11 One Tube Portable..16.00
P-12 Two Tube Portable..22.50

If your Radio Dealer cannot supply you, we will ship direct.

Write for complete catalog.

DEALERS:—KODEL is the sensation of the season. Fans the country over are buying KODEL for its remarkable performance and its amazingly low price. Write for illustrated catalog of the complete line of KODEL quality receivers.

THE KODEL MANUFACTURING CO.
131 W. Third Street
CINCINNATI, OHIO

Start a Movie Show
SMALL CAPITAL STARTS YOU
Big opportunity to become independent. No experience needed. We show you how. Our easy payment plan makes it easy to start. We equip you complete. Our machines used and endorsed by government institutions. Write today for free catalog.
Our Catalog Free Shows You how to Earn $75 to $150 per day
ATLAS MOVING PICTURE CO.
536 S. Dearborn St., Dept. 77, Chicago

INVENTIONS Commercialized
ON A CASH OR ROYALTY BASIS
For the INVENTOR and MANUFACTURER
In Business 25 Years · Complete Facilities · References
ADAM FISHER MFG. CO. 183-D ST. LOUIS, MO.

TYPEWRITER PRICES CUT
World's best makes—Underwood, Remington, Oliver—prices smashed to almost half.
$2 and it's yours
All late models, completely rebuilt and refinished brand new. GUARANTEED for ten YEARS. Send no money—big FREE catalog shows actual machines in full colors. Get our direct-to-you easy payment plan and 10-day free trial offer. *Limited time, so write today.*
Free Trial
International Typewriter Ex., 186 W. Lake St. Dept. 338, Chicago

Carrying Case **FREE** with Big **3 ft. Telescope**
See people and objects miles away just like they were close; see Moon and Stars as never before. Opens over 3 ft. long, 5 sections, brass bound, powerful lenses. Useful and entertaining. "Could tell color of aeroplane 4 miles away."—Mrs. Yarbough. "Watch my boy arrive at school 2 miles away."—Mrs. Horn. "Read numbers on freight cars mile away, see mountains on moon."—A. C. Palmer. Thousands pleased. Write today; on arrival of Big 3 ft. Wonder Telescope with FREE Carrying Case and **Send No Money** Strap pay Postman only $1.55 plus a few pennies postage. Satisfaction Guaranteed.
FERRY & CO., 3224 N. Halsted St., Dept. 1783, CHICAGO

Radio Control

(*Continued from page 89*)

magneto (such as is used in an airplane or automobile engine) is very powerful. In order to neutralize it by radio waves it would, under existing conditions, require an almost immeasurable amount of electric energy at the sending station."

Pure radiodynamics may be said to have progressed in three different directions, though the principles in each line are exactly the same: 1. Radio-controlled boats or torpedoes; 2. Radio-controlled land vehicles, such as automobiles and tanks; 3. Aircraft.

JOHN HAYS HAMMOND, JR., has been a leading proponent of radiodynamics. Nearly 15 years ago he began a series of experiments at his wonderful private laboratory at Gloucester, Mass. There he developed a wireless system capable of controlling a crewless 40-foot gasoline launch of 150 horsepower and making a speed of 25 knots. This vessel proved wholly obedient to the operator's far-distant hand on the land. It darted to and fro. It started and stopped. In every way it proved itself the servant of its master physicist ashore.

As a sample of a radiodynamic vehicle, there was built later at the Hammond laboratory what was termed an "electric dog." This was a boxlike carriage on wheels containing a driving mechanism and a system of electromagnets operating its steering gear. Controlling waves were not invisible radio waves, but visible light waves. The "dog" was fitted with two selenium tubes, or cells, like eyes. These cells were highly sensitive to light. When the light rays struck them, a minute electric current was set up, which in turn operated two very delicate relays. When both cells were illuminated, the driving mechanism worked and the "dog" moved toward the light. When only one cell was lighted, the steering mechanism on the side of that cell was energized and the "dog" swerved. The aggregate behavior of this device, therefore, was to move faithfully, almost as if alive, in the direction of any source of light; and, if there were several sources, to pursue the strongest of them.

MEANS for guidance of the pilotless dirigible or plane are derived from exactly the same sources as described above for ships or motor-cars. So far, the great trouble has been that aircraft move in three-dimensional space and so require an extra set of controls. But even this obstacle was overcome by the army at McCook Field last spring. That brilliant young aviator, the late Lawrence Sperry, flew many times over Long Island as a passenger in a speeding plane guided wholly by radio from below, his hands not touching the controls.

Thus we have as accomplished facts the *crewless ship*, the *chauffeurless automobile*, and the *pilotless plane*. What next?

Next can come only such miracles as came with a rush when the gas engine was perfected. Take first the crewless ship. There is good reason to believe that some day every lake and bay and sea will contain many thousands of them. With the

(*Continued on page 171*)

Radio Control

(Continued from page 170)

perfection of motive mechanism we shall need only the simple control of radiodynamics to send whole flotillas of speeding marine automatons on their way. Freight and mail both will be carried. Enormous space lost nowadays for living quarters and food, as well as great expense of personnel, all will be banished at a single stroke.

OF COURSE, such unique achievements would not come overnight. We didn't have the modern flashing roadster for something more than a quarter of a century. And the first autos were just as feeble and awkward, compared with what we ride in now, as to-day's radio-controlled automaton may be to what will come.

The chauffeurless shore vehicle will be no less profitable when we learn to use it. It is conceivable that automatic tractors will lumber out across the fields, a few years hence, and plow with quenchless ardor under the fiercest solar heat. The farmer? Why he, the loafer, will loll coolly in his radio watch-tower before an electric fan, only moving a finger now and then on the slender control keys that are the reins of his mechanical plowhorse. Or, if we come to motor parkways throughout the country with smooth, uninterrupted flux of traffic, it is quite within the bounds of imagination that a man may send his car back home for the wife simply by switching on its radiodynamic receiving set. The car then will travel straight as a bee for its destination, save when stopped by the unseen radio hand of an electrified traffic cop.

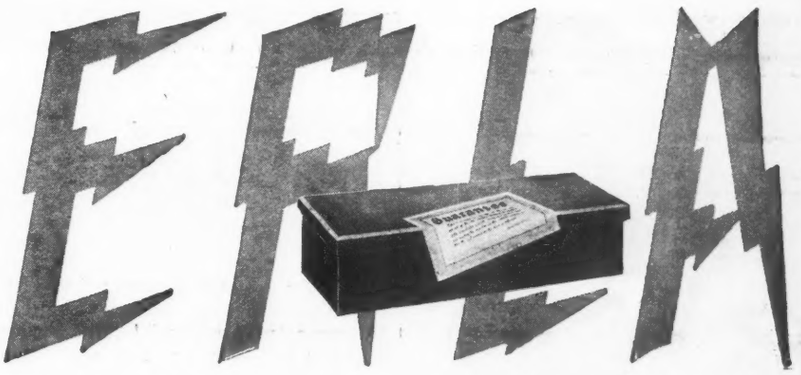
But even these marvels fade to insignificance when we contemplate the bewildering potentialities of the pilotless plane.

"The weapon without an antidote" it has been called. For we can picture 100 submarines carrying 100 planes and their 1000-pound gas bombs arriving off New York without detection, and sending these planes under radio control into the city before daylight. A gas attack of that nature would be impossible to prevent. Times Square and every vestige of life within 40 city blocks of Times Square could be annihilated before the blood-red dawn illuminated the scene of horror.

BUT radiodynamics will be put to many useful purposes long before it is abused for any such gruesome tasks as war with gas suggests. For example, take one of the latest economic tragedies in the state of New York, the fierce forest fires that last fall raged up through Rensselaer and other counties, doing irreparable damage to precious forests. All available human agencies were pitiably helpless before the holocaust. The trouble was that *men couldn't get at the fire.*

Some day in the not distant future radio-controlled planes will fight our forest fires for us. Because they will be pilotless they will be smaller. For the same reason they will be cheaper. They will be able to take chances that the bravest pilot would never take; for their loss never would mean the loss of human

(Continued on page 172)



Supereflex Means MORE POWER PER TUBE

Erla Supereflex makes tubes do triple duty. One tube actually does the work of three that would be needed otherwise. Three tubes do the work of five, unquestionably! That is why simple, compact, inexpensive Erla Supereflex receivers equal or surpass the performance of costliest, temperamental multi-stage radio sets.

More power, tube for tube, is basic in Erla Supereflex. Nothing else can "make up for it." Greater power in Erla Supereflex just simply means finer radio, which you can afford.

For you yourself can confidently build these matchless Erla circuits with Erla Supereflex *CIR-KIT*.

CIR-KIT is a complete array of Erla Scientific Precision Apparatus, especially created to make Supereflex possible. *CIR-KIT* provides clear, simple instructions for perfect assembly. Blueprints are full size. The panel is pre-drilled for you. The baseboard is marked to locate every unit accurately. The famous Erla Solderless Connectors do away with soldering entirely.

With screwdriver, pliers and *CIR-KIT* you are sure of a set that will make you proud, both for appearance and performance. The cost is very moderate. Yet the range, volume, selectivity AND TONE PURITY are rarely equaled at any price, because Supereflex does give you more power, tube for tube.

Electrical Research Laboratories
Department S, 2500 Cottage Grove Avenue, Chicago

CIR-KIT

Drive This Beautiful Raceabout Instead of Your OLD FORD

Choice of Four Colors; Fiat or the Bullet Nose Radiator Shell. Send for 1925 Free Catalog of New Auto Acces', Bodies and Speed Equipment. Direct from Factory.

AMERICAN TOP AND BODY CO., Beech Street DELPHI, IND.

HONEYCOMB COILS

The Universal all-wave inductance. Back and front panel mountings. Send 25c for Super Het., R. F. and Honeycomb Coil Circuits and Complete Catalog.

Chas. A. Branston, Inc. Dept. 9. 815 Main St. Buffalo, N. Y.

NEW VEST POCKET ADDING MACHINE

Adds as rapidly and accurately as a $300 machine, yet fits the vest pocket. Mechanically perfect. Easy to operate—nothing to get out of order. Everyone who uses figures should own one. Counts Up to 999,999,999

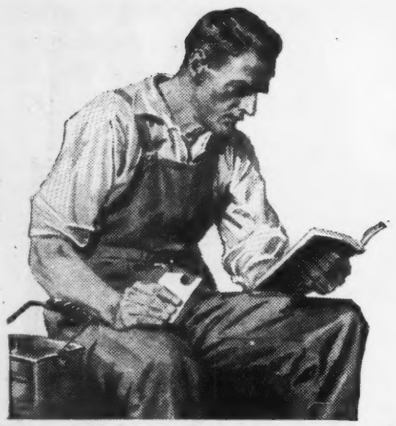
$2.95

Total visible at all times. A pull of the finger clears it. Don't carry a pocket full of pencil stubs and scrap paper to do your figuring. Carry a Ve-Po-Ad.

10 Days Trial Send no money. Just name and address and we will send machine postpaid. Pay postman on delivery $2.95. Use it for 10 days to prove it does all we claim. If not perfectly satisfied we will refund your money. Limited supply. Send order today. Reliable Adding Mach. Corp., Dpt. 74 170 W. Washington St., Chicago, Ill.

AGENTS Here's a money maker. Everybody wants one. Splendid profit. Write for special offer.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.



The Hour That Counts!

When you see a man putting in his noon hour learning more about his work, you see a man who won't stay down. He'll never be satisfied until he hits the top. And he'll get there!

In shops, factories, offices, stores, in every line of industry, men are holding splendid positions won through spare-time study with the International Correspondence Schools. To-day they are earning four or five times—yes, some of them *ten* times as much money as when they started.

Employers everywhere are looking for men who really want to get ahead. If *you* want to make more money, show your employer that you're trying to be *worth* more money.

For 33 years the International Correspondence Schools have been training men and women right in their own homes.

Thousands upon thousands of men have stepped up in just this way. More than 180,000 are studying now. Can you afford to let another hour pass without making *your* start toward something better? Here is all we ask—without cost, without obligation, just mark and mail this coupon!

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7640-D, Scranton, Penna.

Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

BUSINESS TRAINING COURSES

☐ Business Management	☐ Salesmanship
☐ Industrial Management	☐ Advertising
☐ Personnel Organization	☐ Better Letters
☐ Traffic Management	☐ Show Card Lettering
☐ Business Law	☐ Stenography and Typing
☐ Banking and Banking Law	☐ Business English
☐ Accountancy (including C.P.A.)	☐ Civil Service
☐ Nicholson Cost Accounting	☐ Railway Mail Clerk
☐ Bookkeeping	☐ Common School Subjects
☐ Private Secretary	☐ High School Subjects
☐ Spanish ☐ French	☐ Illustrating

TECHNICAL AND INDUSTRIAL COURSES

☐ Electrical Engineering	☐ Architect
☐ Electric Lighting	☐ Architects' Blue Prints
☐ Mechanical Engineer	☐ Contractor and Builder
☐ Mechanical Draftsman	☐ Architectural Draftsman
☐ Machine Shop Practice	☐ Concrete Builder
☐ Railroad Positions	☐ Structural Engineer
☐ Gas Engine Operating	☐ Chemistry ☐ Pharmacy
☐ Civil Engineer	☐ Automobile Work
☐ Surveying and Mapping	☐ Airplane Engines
☐ Metallurgy ☐ Mining	☐ Agriculture and Poultry
☐ Steam Engineering ☐ Radio	☐ Mathematics

Name.....
Street Address..... 3-6-24
City..... State.....
Occupation.....

Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

$7.65 IN 4 HOURS SPARE TIME

Hampton made $7.65 in four hours spare time just wearing this Beautiful Hand-Tailored Cap, made to his Individual Measure, and you can do the same—you can easily earn $50—$75 a week in your spare time.

Get This Cap FREE

I want to give you this cap FREE—I know your friends will be delighted with its Class, Style and Fit and you will make a generous profit taking their orders. Choice of 6 styles and 25 fine fabrics. Send your name right away and I'll tell you how to make $50 a week in your spare time. Write me at once. J. W. Taylor, Pres., Taylor Cap Manufacturers, Dept. 9-C, Cincinnati, O.

Radio Control—Marvel of the Future

(*Continued from page 171*)

life. They will be directed from a portable station. Or they may even be driven in a chemical-carrying swarm before a mother plane. In either event they will save us millions and millions of dollars by eliminating the sickening annual loss by fire of our forested lands all over the country.

Already we spray crops by plane. Farmers and ranchmen admit this method is unexpectedly successful. But the government has to help; the farmer can't afford to use the method. The *pilot* is too expensive. The radio-controlled pilotless plane is the only satisfactory answer.

ONE estimate of the annual value to the country of our official weather reports gives the remarkable figure of $250,000,000. Without regard to its accuracy, this figure at least indicates how much agriculture and commerce of all sorts have come to depend on the weather man's predictions. But, alas, we all know how often that much-maligned person makes mistakes. Soon, however, he will have radiodynamics to help him. In addition to a relatively few scattered observation stations, the United States Weather Bureau will employ hundreds of flying automatons that will be dispatched to circle afar and return like so many boomerangs. Each plane will carry a set of recording instruments that will bring back written messages accurately describing weather conditions in the area covered. From these records meteorological prophecy may cease to be a system of skilful guesswork and with their assistance take on the nature of a fixed science.

Radio-controlled planes doubtless will be used to carry mail. Night flying pilots and their awful perils no longer will exist. A crashed plane may burn up a few letters, but never will it scorch the quivering flesh of an unconscious flier. Such planes will leave the ocean liner after she has sailed and meet her before she lands, thus cutting the business-mail interval at least in half.

RADIODYNAMIC advertising campaigns may be launched from time to time with the express permission of the government and after paying a high tax. Automatons then will distribute a nation-wide spread of pamphlets describing a new brand of tobacco or scented soap.

Miniature radio-controlled automatons will flit between skyscrapers carrying orders and inter-office memorandums.

The explorer no longer will have his base of supplies in the wilderness, but near home. His men there will send him food and other luxuries daily by air.

The man who commutes to his office by air even may be able to send his plane back home simply by turning its radio control over to one of the office force.

It is all very thrilling to visualize. And it certainly all seems very far-fetched. Yet the writer remembers very well as a boy, less than 30 years ago, when a highly intelligent engineer said it might well be several generations before an engine were developed that would give us a practical automobile or airplane. We have them both today.

How to Cut Down Battery Costs

(*Continued from page 90*)

charged at all times at little or no cost to you for current. With this system it is desirable to test the battery with a hydrometer once a week, and if you find you are taking more current out of it than you are putting in, it is easy enough to plug in the electric toaster in place of the lamp bulb and so give the battery an extra charge for a few hours.

A five-tube set, using quarter-ampere tubes, takes 1¼ ampere hours of current out of the battery when the set is operated steadily for one hour. A 60-watt electric bulb would put back into the battery half an ampere hour during the same period. From these figures, it is easy to figure out whether the battery is likely to need an extra charge at the end of the week.

BEFORE you connect the plate-voltage filter system shown in Fig. 2 with the binding posts of the receiver, and before you make the connections with the storage A battery from the triple-pole, double-throw switch shown in Fig. 1, make a careful test to determine which wire is positive, as shown in Fig. 3. Dip the two bared ends of the wire into a glass full of water into which a pinch of table salt has been stirred. You will note that bubbles will form and rise to the surface from the end of one wire. This is always the negative. It is advisable to make this test on the two ends of the drop cord from the table lamp formed by cutting *one* strand of the two that make up the drop cord.

The three-pole, double-throw switch is used so the battery will be disconnected from the power line and connected with the radio set when the switch is thrown to the left, as shown in Fig. 1, and at the same time the light circuit will be closed independently so that the table lamp can be used. When thrown the other way, the switch connects the battery in series with the light, after disconnecting it from the radio set, so that there is not any chance of a short circuit by way of the B battery supply filter system.

Users of dry-cell tube outfits ordinarily find that the expense of renewing A batteries is greater than for B batteries. If you have found this to be the case, a simple way to cut down the expense for A batteries is to purchase a storage battery and keep it charged according to the diagram in Fig. 1.

IN NEXT month's issue, Alfred P. Lane, radio editor of POPULAR SCIENCE MONTHLY, will describe a simple method of adding either one or two stages of radio frequency.

Here's an unusual constructional article—one that thousands of radio fans have been waiting for. You won't want to miss it.

ATKINS

SILVER STEEL

SAWS

THE finest saw Atkins ever made—the Elite of the Saw World. You will find the Atkins "Four Hundred" a wonderful saw. Ready for a lifetime of super-service in sawing. Blade of "Silver Steel," taper ground to insure the easiest cutting, longest wear and edge holding qualities. Its genuine rosewood handle, the nickeled screws and polished blade indicate its extraordinary quality and workmanship. Ask *your* dealer.

Pass All Tests!

The engineers of Popular Science Institute place their seal on Atkins saws for acknowledged standards of quality, workmanship and materials. Since 1857 the Atkins trademark has stood for even higher standards on saws for every use in cutting wood or metal. It will pay you to look for the Atkins name on ANY Saw.

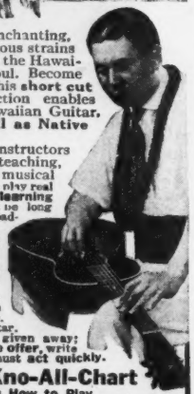
"Saw Sense," "The Saw in the Shop," or "The Saw on the Farm," are valuable books filled with saw information. We'll gladly send you any of them if you will address Dept. D-20—

E. C. ATKINS & CO., INC., (ESTABLISHED 1857) INDIANAPOLIS, U.S.A.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.

Quickly Learn to Play Hawaiian Guitar

Play Like This Native



Bring the romantic, enchanting, entrancing and melodious strains of the great instrument of the Hawaiian Islands into your soul. Become popular and successful. This **short cut method** of home instruction enables you to quickly master Hawaiian Guitar, so you will **play as well as Native Hawaiians.**

Our staff of Hawaiian instructors have perfected a method of teaching, so **simple,** that without musical knowledge, you quickly learn to play real music from notes. **Simple as learning your A, B, C's** and it will not be long before you will play latest Broadway hits.

Only four simple motions to learn. You will then play any music, whether it be popular, dance or classical. Almost from first lesson you play love songs like Aloha Oe.

To help you get started, we **furnish free** when you enroll as a student, a beautiful, full tone, genuine, $18.00 Hawaiian Guitar. Only 1,000 free instruments given away; if you want to get in on **free offer,** write for particulars at once—you must **act quickly.**

New Invention—Kno-All-Chart

Quickly Teaches You How to Play

The **newest invention of our Hawaiian instructor,** which is exclusively used by us and which we call the **"Kno-All Chart,"** quickly teaches you how to play and read notes. So simple is this device that anyone can understand it and begin to **play immediately.**

Picture Method Easy

We do not depend upon our printed instructions alone for your success as a student, but we also supply you with many pictures of our professors' playing. This enables you to imitate the pictures. **Isn't this easy?**

Phonograph Records Free

As an additional guide, we also furnish you with **phonograph records** of our Hawaiian instructors' own playing of the piece you are learning. This practically brings our professors from our studio to your own home and enables you to listen to their playing just as if they were actually in front of you.

Genuine $18.00 Hawaiian Guitar Free

Free $18 Hawaiian Guitar when you enroll

Enroll as a student, and secure **free,** a beautiful, full tone, genuine $18.00 Hawaiian Guitar. We also furnish every bit of equipment so it is never necessary for you to spend an extra penny. When you graduate, you get a **beautifully engraved diploma** and after graduation, we also give you **six months' free service** and consultation. Send for free particulars now.

Send for Free First Lesson and Book

So positive are we you will become one of our students, that if you write at once, we will send you **free,** our first lesson which will enable you to see just what you can expect when you enroll. You will also receive our **big book** of full particulars. Write for your copy and **free lesson** today. You will be one of the **lucky ones** to have a **free Hawaiian Guitar** reserved for you—**write at once.**

JAZZ Your Way to Popularity and Success

No forming class to wait for. Start at once and join band wagon of success and popularity. Do it through Hawaiian Guitar

Hawaiian Studio No. 843
of New York Academy of Music
100 Fifth Ave., New York, N. Y.

Free $18 Hawaiian Guitar when you enroll

$3 down Brings you a Genuine UNDERWOOD TYPEWRITER

10 DAYS FREE TRIAL Your $3.00 unconditionally returned if at end of 10 days you are not satisfied with this late model UNDERWOOD typewriter rebuilt by the famous Shipman Ward Process.

GREAT PRICE SAVING Direct to you from the largest typewriter factory of its kind in the world by our money saving methods.

EASY MONTHLY PAYMENTS So small that you will not notice it while you enjoy the use of this wonderful machine.

FREE BOOK OF FACTS Explaining Shipman Ward's wonderful system of rebuilding typewriters.

Mail This Coupon

5 Year Guarantee

Shipman Ward Mfg. Company
2148 Shipman Building
4611-9 Ravenswood Ave., Chicago

Please send me a copy of your free book of facts explaining bargain offer.

Name .....
St. and No. .....
City ..... State .....

How to Build a Two-Tube Set

(*Continued from page 93*)

Be sure to place socket *L* with the grid and plate binding posts toward condenser *E*, and fasten socket *M* with grid and plate binding posts toward the rear, so that the filament binding posts on this socket will be nearest the panel *Q*. The audio-frequency transformer *I* should be placed with the secondary binding posts toward socket *L* and the secondary binding posts on transformer *J* should be toward socket *M*.

You will note that in the wiring diagram given in Fig. 6, all the wires that go to make up a one-tube receiver are marked in solid lines, while dotted lines are used to indicate the additional wires necessary if two tubes are to be used. The following description of the wiring will cover the necessary connections for two tubes. If you want to build the receiver as a one-tube outfit, just disregard the instructions specifying wires that are indicated by dotted lines in Fig. 1. Incidentally, this is a good plan if you live near several broadcasting stations, since one dry-cell tube will operate a loudspeaker with good volume.

AS EACH wire is soldered in place, go over the line that indicates the wire in Fig. 1 with a blue or red pencil. This will enable you to note any wire that you may accidentally have missed. Do not forget the positions of tuning inductances *AB* and *CD*, and be sure to bend the wires so that they will not interfere with them.

The filament circuit should be wired first. Run a wire from binding post No. 3 to one binding post on the rheostat *K*. From the other binding post on the rheostat run a wire to the nearest filament terminal of socket *L* and continue it around to the left-hand (as seen from the rear in Fig. 1) binding post on socket *M* nearest panel *Q*. Next, run a wire from the binding post No. 4 to the remaining filament terminals of both sockets *L* and *M*.

Now connect a wire from the stator plates of condenser *E* to the grid terminal of socket *L*, and another from the rotary plates of the same condenser to one of the secondary terminals of transformer *I*. Connect the other secondary terminal of the same transformer with the wire that runs from binding post No. 3 to the rheostat. Fixed condenser *H* can be soldered between these two wires at any convenient point. See Fig. 6.

Binding post No. 5 can be connected directly with binding post No. 4. Binding post No. 6 is next connected with the top soldering lugs of jacks *O* and *P*. Running a wire from the other lug of jack *P* to the plate terminal of socket *M* completes the connections with this jack.

The crystal detector *N* now can be wired. The lower terminal of it is connected with the stator plates of condenser *F* and the other terminal goes to the nearest primary binding post of transformer *I*. The remaining primary terminal of transformer *I* goes to the rotary plates of condenser *F*.

If you are building the complete two-tube set, the next wiring is to connect up transformer *J*. The grid terminal of this transformer goes to the grid terminal of socket *M*; the filament terminal of *J* is connected with the wire from binding post No. 3. Now screw coil *CD* in place and run a wire from the upper terminal of coil *C* to the lower lug on jack *O*. After this you can connect the second from the bottom lug of jack *O* with the plate terminal of transformer *J*, and the next to the top lug of jack *O* with the plus B terminal of the transformer *J*.

Now run a wire from the plate binding post of socket *L* to the other terminal of coil *C*, and from the wire running from the jack to this coil, connect the fixed condenser *G* over to the wire from binding post No. 3 at any convenient point. See Fig. 6. Be sure that the condenser *G* is connected with the jack side of the coil, for if you connect it with the plate side, the receiver will not work at all.

Coil *D* can be connected with condenser *F*, the lower terminal going to the stator plates, and the upper terminal to the rotary plates.

Now you are ready to place coil *AB* in position. Connect the lower terminal of *B* with the rotary plates of the condenser *E*, and the upper terminal with the stator plates of the same condenser. The last two connections are to the antenna and ground binding posts, Nos. 1 and 2, from the terminals of coil *A*.

You will note that no instructions have been given as to the direction of the winding of the coils with relation to each other. It makes no difference which way they are wound. Likewise, the specific terminal connections to transformer *I* have not been given, for it is well, in this circuit, to try reversing the primary connections to this transformer.

In many reflex circuits there are a number of factors that may spoil its operation. In this set there is just one point to watch out for, and that is the number of turns in coil *C*. Too many turns will cause the receiver to squeal on the lower wave lengths. Too few turns will make the receiver not sensitive.

WITH an adjustable crystal at *N* it is easy to tell when you have everything right, for the receiver should squeal continuously when the catwhisker is not in contact with the crystal, and should disappear when the whisker makes contact.

It might be well to point out here that any type of crystal suitable for use in a plain crystal circuit will work perfectly in this receiver, since the crystal is not subjected to the current from the battery.

The success of the receiver depends to a large extent on a good, sensitive crystal. Therefore, if you use a fixed crystal, try several before you start to alter the number of turns in coil *C*.

Ninety volts is about right for the B battery, but in actual test, excellent signal loudspeaker strength was obtained with two 1½-volt dry-battery tubes and only 48 volts of B battery.

This seal on a radio or tool advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 33.